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Status of the Atlantic salmon (*Salmo salar* L.) Stocks of Lomond River, Torrent River and Western Arm Brook, Newfoundland, 2000

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ABSTRACT

Returns of small salmon to Lomond River were 21% less than in 1999 and 10% less than the 1992-99 mean. Returns of large salmon were 33% less than in 1999. Returns of small salmon to Torrent River were 10% less than in 1999 and 14% lower than the 1992-99 mean. Returns of large salmon in 2000 were 43% higher than in 1999 and 28% higher than the 1992-99 mean. Returns of small salmon to Western Arm Brook were 43% and 55% higher than in 1999 and the 1992-99 mean, respectively. Returns of large salmon were the second highest since 1992 and were well above the returns in 1999 and the 1992-99 mean. Returns of both small and large salmon to all three rivers were higher than the 1984-91 means indicating improvements in the stocks since the commercial salmon fishery moratorium. The proportion of large salmon was higher than the 1984-91 mean on all three rivers. It is highly unlikely that the conservation requirement was not achieved on any of the three rivers in 2000. On the basis of the smolt production at Western Arm Brook in 2000, returns of 1SW salmon in 2001 are expected to be lower than in 2000 but higher than the 1992-99 mean provided marine survival remains the same. Marine survival of smolts to returning 1SW salmon at Western Arm Brook was 11.0% in 2000. If marine survival is actually closer to the 1992-99 mean (7.0%), returns of small salmon in 2001 will be about 40% lower than in 2000. Spawning escapements are expected to exceed conservation requirements on all three rivers in 2001 assuming marine survival remains the same as in 2000. A decline in marine survival similar to the decline observed in 1997, would mean that conservation requirements would likely not be achieved on Western Arm Brook in 2001. Due to overall improvements in stocks and the added control afforded by the river classification system, there may be opportunities on these rivers for increased harvests below counting facilities. However, given the uncertainty in annual marine survival observed for Western Arm Brook it is cautioned that harvests on this river should not be permitted until the conservation requirement (300 salmon) has been achieved. Expansion of fisheries above counting facilities on all three selected rivers is not recommended unless angling catches can be an accurately determined.

RÉSUMÉ

La remonte de petits saumons dans la rivière Lomond était de 21% moins élevée qu'en 1999 et de 10% inférieure à la moyenne de 1992-1999, tandis que la remonte de gros saumons était de 33% moins élevée qu'en 1999. En 2000, dans la rivière Torrent, la remonte de petits saumons était de 10% moins élevée qu'en 1999 et de 14% plus faible que la moyenne pour 1992-1999, et celle des gros saumons était de 43% plus élevée qu'en 1999 et de 28% supérieure à la moyenne de 1992-1999. La remonte de petits saumons dans le ruisseau Western Arm était de 43% et de 55% plus élevée qu'en 1999 et que la moyenne pour 1992-1999, respectivement, tandis que la remonte de gros saumons dans ce ruisseau était la deuxième plus forte enregistrée depuis 1992, dépassant largement celle de 1999 et la moyenne de 1992-1999. Les remontes de petits et de gros saumons dans les trois cours d'eau étaient plus élevées que les moyennes de 1984-1991, ce qui indique une amélioration de l'état des stocks depuis la mise en œuvre du moratoire sur la pêche commerciale du saumon. La proportion de gros saumons dans les trois cours d'eau était plus forte que la moyenne pour 1984-1991. Il est fort peu probable que les besoins au titre de la conservation dans ces trois cours d'eau n'aient pas été satisfaits en 1999. En se fondant sur la production de saumoneaux dans le ruisseau Western Arm en 2000, on s'attend à ce que la remonte de saumons unibermarins en 2001 soit plus faible qu'en 2001, mais plus forte que la moyenne de 1992-1999, pourvu que le taux de survie en mer ne change pas. Le taux de survie en mer des saumoneaux revenus au ruisseau Western Arm à l'état de saumons unibermarins se chiffrait à 11,0% en 2000. Si la survie en mer s'approche davantage de la moyenne de 1992-1999, soit 7,0%, la remonte de petits saumons en 2001 sera d'environ 40% inférieure à celle de 2000. On s'attend à ce que les échappées de géniteurs dans les trois cours d'eau soient supérieures aux besoins au titre de la conservation en 2001, pourvu que le taux de survie en mer soit semblable à celui de 2000. Une baisse du taux de survie en mer semblable à celle observée en 1997 signifierait que les besoins au titre de la conservation dans le ruisseau Western Arm ne seront probablement pas comblés en 2000. Il sera peut-être possible de capturer plus de saumons en aval des barrières de dénombrement installées dans ces trois cours d'eau grâce à l'amélioration générale de l'état des stocks et au contrôle accru que permet le système de classification des cours d'eau. Mais à cause de l'incertitude du taux annuel de survie en mer des saumons du ruisseau Western Arm, la pêche dans ce cours d'eau est déconseillée tant que le besoin au titre de la conservation (300 saumons) n'aura pas été comblé. En outre, l'expansion des pêches en amont des barrières de dénombrement installées dans ces trois cours d'eau n'est pas recommandée à moins que le niveau des prises récréatives puisse être établi avec précision.

INTRODUCTION

Lomond River, Torrent River, and Western Arm Brook are three of fourteen scheduled rivers in Salmon Fishing Area (SFA) 14A (Fig. 1). Lomond River has a drainage area of 470 km^2. Torrent River has 619 km^2 and Western Arm Brook has 149 km^2 (Porter et al., MS 1974). Adult Atlantic salmon are monitored on all three rivers and smolt production is monitored on Western Arm Brook. Adult salmon returns have been monitored at fishways on Lomond River and Torrent River since the 1960s and at a counting fence on Western Arm Brook since 1971. Smolt production has also been monitored at the counting fence on Western Arm Brook on since 1971. The fishways on Lomond River and Torrent River are located approximately 5.0 km and 2.0 km, respectively, upstream from the mouth of the river. The counting fence on Western Arm Brook is located just above the head of tide.

The recreational salmon fishery on Lomond River is downstream from the fishway (since 1978) and was controlled by an individual river quota of 350 small (< 63 cm) salmon retained from 1986 to 1994. The quota was increased to 375 small salmon retained in 1995 until 1998. The recreational salmon fishery on Torrent River is also downstream from the fishway and prior to 1999 was restricted to catch and release angling only until a minimum spawning escapement had passed upstream through the fishway. Retention angling was then permitted. The minimum escapement was first set at 1,000 salmon in the 1970s and was reduced to 750 salmon in 1995. Catch and release angling prior to the minimum escapement being achieved was first permitted in 1996. On Western Arm Brook, 2000 angling was permitted from the mouth of the river to approximately 0.5km upstream. The purpose was to collect biological information from small salmon returning to Western Arm Brook. A river quota of 100 small salmon was set, hook and release of small salmon was prohibited, large ($\geq$ 63 cm) salmon had to be released and a bag limit was one small salmon per day. The rest of Western Arm Brook remained closed to angling as per established since 1989.

The commercial salmon fishery in insular Newfoundland including SFA 14A has been under a moratorium since 1992. This was a major management change to increase the number of adult salmon returning to rivers. In addition, stricter controls were implemented in the recreational fishery to increase spawning escapements. The commercial cod fishery moratorium implemented in this area in August 1993 was also expected to contribute to an increase in adult returns. However, there was still a potential, in 1992, for high fishing mortality on salmon at sea due to the presence of cod traps.

The effect of the commercial salmon fishery moratorium and other management changes on adult salmon returns in 1992-2000 can be examined on Lomond River, Torrent River and Western Arm Brook based on counts of adult salmon at counting facilities compared to previous years (1984-91).

Because recreational salmon fishery catches are known for these rivers, spawning escapements can be determined and evaluated relative to previous years. Habitat information and salmon biological characteristics are also known. Therefore, potential egg deposition can be determined based on the spawning escapements and evaluated relative to established conservation egg deposition requirements. The effect of the moratorium on recruitment can also be evaluated by adjusting returns of small salmon to account for commercial exploitation. Annual variability in marine survival of smolts can be also evaluated at Western Arm Brook relative to pre-moratorium years based on the percentage returning as adult one-sea-winter (1SW) salmon the following year. In addition, possible causes of variable marine survival can be examined. Following the unexpected decrease in marine survival of salmon smolts in 1997, several possible sources of mortality were identified (Dempson et al., 1998) including changes in run timing, water temperature and predation by birds (CSAS, 1998).

METHODS

RECREATIONAL FISHERY

Recreational salmon fishery data on Lomond River and Torrent River were estimated based on the licence stub return system in 1997-2000 (O'Connell, et al. MS 1998). Previously, recreational salmon fishery catch data were compiled from weekly reports completed by Department of Fisheries and Oceans (DFO) river guardians (Mullins et al., MS 1989; Mullins and Jones, MS 1993a; and Mullins and Jones, MS 1993b). DFO data may not be directly comparable to data from the licence stub return system.

ADULT RETURNS AND SPAWNING ESCAPEMENTS

a) Adult Counts and Run Timing

Counting facilities on all three rivers were monitored on a daily basis the same as in previous years. The only exception was that the fishway on Lomond River was not monitored in 1989-91, but fish were observed passing upstream through the fishway. The counts of small and large salmon in those years were estimated based on the mean of the previous three years when fisheries management plans were similar.

Run timing of small salmon was measured as the date that the 25^{th}, 50^{th} and 75^{th} percentiles of cumulative counts occurred at each counting facility.

Water temperature (C) at the counting fence and in the estuary of Western Arm Brook was recorded hourly using a 'Hobo-temp' temperature logger. The temperature logger at the counting fence was placed at the bottom of the smolt

trap and the logger in the estuary was placed at a depth of approximately 1 m at low tide.

Water levels at the Lomond River and Torrent River fishways were measured from gauges fixed to the outside of the fishway structure. Water level at Western Arm Brook was measured from a metre stick attached to the adult counting trap.

b) Adult Returns

The total returns to the river (TRR) of adult small and large salmon were based on counts at counting facilities and removals in the recreational fishery below the counting facility according to the equation:

$$\mathbf{TRR = CNT + RET + HRM}$$

Where:

CNT = count of salmon at counting facility
RET = number of salmon retained
HRM = hook-and-release mortality

$$\mathbf{HRM = REL \times 0.1}$$

Where:

REL = number of salmon hooked and released

Removals in the recreational salmon fishery include retained fish plus an assumed mortality rate of 0.1 on released small and large salmon. This mortality rate was based on consultations with anglers. It was assumed that catch and release mortality on Lomond River and Torrent River occurred only below the counting facilities where angling was permitted. No adjustments were made for any other unrecorded mortality above or below these counting facilities. The total return to Western Arm Brook in 2000 included the total count at the counting fence plus the small salmon retained below the counting fence. Catch and release angling of small salmon was not permitted at Western Arm Brook in 2000.

Total returns of small and large salmon were calculated separately.

Returns of small and large salmon were compared with those in 1999 and the 1992-99 mean.

c) Spawning Escapements

Spawning escapements of small and large salmon to each river were calculated separately by subtracting retained catches, mortality due to catch and release and other known removals from the total returns:

SE = TRR - RET - HRM - OTH

Where:

TRR = total return of small or large salmon
RET = number of salmon retained
HRM = hook-and-release mortality (10% of hooked and released fish)
OTH = other known removals

CONSERVATION REQUIREMENTS AND POTENTIAL EGG DEPOSITIONS

a) Conservation Requirements

Conservation requirements, were calculated in terms of eggs, based on 2.4 eggs/m^2 (Elson, 1975) for fluvial habitat (Elson, 1957) on all three rivers, and 368 eggs/ha for lacustrine habitat on Lomond River and 105 eggs/ha for Torrent River and Western Arm Brook (O'Connell et al., MS 1991). The egg deposition rate for fluvial habitat includes an adjustment for poaching and disease; whereas, the rate for lacustrine habitat does not include an adjustment. The conservation requirement (CR) for each river was calculated according to the formulae:

1. Lomond River

CR = (fluvial area x 2.4) + (lacustrine area x 105)

2. Torrent River and Western Arm Brook

CR = (fluvial area x 2.4) + (lacustrine area x 368)

The habitat measurements available for Lomond River, Torrent River and Western Arm Brook are as follows:

River	Fluvial Area (m2)	Lacustrine Area (ha)
Lomond River	215,600	1,570
Torrent River	516,800	2,323
Western Arm Brook	290,000	2,017

It is important to note that for Lomond River, the amount of available fluvial habitat was measured from detailed stream surveys. For Torrent River and Western Arm Brook, available fluvial habitat was based on aerial surveys (Traverse, 1971). Available lacustrine habitat on the three rivers was measured from 1:50,000 scale topographic maps using the appropriate dot grid scale.

Conservation requirements in terms of eggs were expressed in terms of a spawning requirement of adult salmon based on mean weights and proportion of females for 1992-96. The means of these years were used to account for potential change in mean weight as a result of elimination of selective

commercial fishing mortality since 1992. The minimum proportion of large salmon and the maximum proportion of small salmon observed in 1992-96 were used to apportion the spawning requirements into numbers of small and large salmon.

Conservation requirements in terms of eggs as well as the number of spawning adult salmon that would normally be required to achieve this level of egg deposition are as follows (Mullins, MS 1997):

	Conservation Requirements			
		Spawners		
River	Eggs	Small	Large	Total
Lomond River	1,095,200	557	23	580
Torrent River	1,484,235	562	30	592
Western Arm Brook	907,785	284	3	287

b) Potential Egg Deposition

Potential egg deposition (ED) by small and large salmon on each river was estimated by the following formulae based on available biological information:

$$ED = SE \times PF \times F$$

Where:

SE = spawning escapement
PF = proportion female
F = fecundity

$$F = RF \times MW$$

Where:

RF = relative fecundity (# eggs/kg)
MW = mean weight of females

The relative fecundity of 1,783 eggs/kg of body weight for small and large salmon was estimated from an average of 3,388 (N=264) eggs per female for Western Arm Brook in 1979-80 (Chadwick et al., 1986) based on a mean weight of 1.90 kg.

On Lomond River and Torrent River in 2000 mean weight and proportion female were obtained from sampling conducted at the counting facilities and in the recreational salmon fishery as in previous years.

At Western Arm Brook, the mean weight and proportion female for small salmon were obtained from biological sampling carried out by angling in the lower part of the river. The general public was invited to angle fish for the purpose of biological sampling under experimental license. The target sample size was 100 small salmon. Salmon were angled from the mouth of the river to approximately 0.5km upstream, with the exception of 25m above and below the

counting fence. With some exceptions, anglers could fish between 0600–2200 hours each day under the same conditions as on all other scheduled salmon rivers. The exceptions were that anglers were restricted to a daily bag limit of one small salmon and they had to report to DFO staff on-site before and after fishing and to allow their catch to be sampled. Hook and release of small salmon was not prohibited. The angler's name, license number, start and finish times, and catch were recorded. Small salmon retained were sampled for fork length, weight, internal sex, and scales. The gonads of female fish were removed and placed in Gilson's fluid for later fecundity determination.

Sex composition of salmon sampled at counting facilities was usually determined by external examination. Sex composition of salmon sampled in the recreational salmon fishery was by internal examination. For small salmon, only information from internally sexed fish was used to estimate egg deposition, whereas for large salmon, information from both internally and externally sexed fish was used.

Because samples size of biological characteristics information were small (<30) in some years, pooling of biological characteristics data was sometimes necessary in order to obtain an adequate sample size. This was particularly important for the years since 1992 when there was a potential for increased body size due to the closure of the commercial salmon fishery.

The percentage of the conservation egg deposition requirement (CR) achieved was calculated according to the formula:

% Achieved = ED (small + large) / CR

There is some uncertainty introduced into this calculation due to possible errors in estimates of biological parameters used to derive point estimates for egg deposition and the conservation requirement. The uncertainty associated with the calculation of egg deposition was expressed in the form of a probability distribution using simulation techniques and a 95% confidence interval was generated. The technique involved recalculating the estimate of egg deposition 5000 times while allowing the biological parameter values used in the calculation to vary with each calculation or simulation. The following parameters were allowed to vary within a uniform distribution with each simulation step: 1) fecundity of small and large salmon and 2) the proportion of female small and large salmon. Fecundity was allowed to vary by a 20% coefficient of variation and proportion female was varied within a uniform distribution based on the available sample sizes. The frequency and probability distributions of the resulting egg deposition estimates were plotted to determine the mode and the 2.5^{th} and 97.5^{th} percentiles.

WESTERN ARM BROOK SMOLT COUNTS AND SURVIVAL

Annual smolt production has been recorded at the counting fence on Western Arm Brook since 1971. Five out of every 500 smolts less than 25.0 cm fork length were sampled for fork length, whole weight, sex and scales. Condition factor (CF) was calculated for sampled smolt as:

$$CF = WWT / FLT^3 \times 100$$

Where:
WWT = whole weight (gm)
FLT = fork length (cm)

Marine survival of smolts was taken as the percentage of the smolt production in year *i* that returned to the river as virgin one-sea-winter (1SW) adult salmon in year *i*+1. The number of 1SW returns was calculated from total returns of small salmon based on the proportion of 1SW salmon sampled during the biological sampling experiment.

In the absence of marine exploitation following the commercial salmon fishery moratorium in 1992, returns of small salmon were assumed to represent the total recruitment. Therefore, the marine survival calculation in these years was not directly comparable to previous years. O'Connell, et al. (MS 1997) described a technique whereby it was possible to retrospectively construct, in selected rivers with counting facilities, total recruitment of small salmon (or total number of small salmon recruits) prior to any exploitation. Small salmon recruits for Western Arm Brook prior to 1992 were derived based on total returns to the river and an assumed commercial exploitation rate of 0.60.

NET MARKS AND SCARS

All adult salmon counted at counting facilities on Lomond River, Torrent River and Western Arm Brook were examined for the presence of external marks and scars. Salmon remained in the water for examination.

BIRD PREDATION

Activities and numbers of birds were recorded during counting fence operations at Western Arm Brook in 2000. Three observation points were selected: one at the counting fence and two in the estuary (Fig. 2). Observation times at the counting fence were at 0800, 1200 and 1600 hours during trap checks and twice per day at each site in the estuary, once in the morning and once in the afternoon. The duration of observations was 15 minutes at each site using both the naked eye and binoculars (10x50mm). The number and species

of birds flying, standing, swimming and feeding as well as the type of food, if any, were recorded.

JUVENILE DENSITIES

Juvenile salmon densities (number of fish per $100m^2$) are available for three sites monitored annually on Western Arm Brook since 1985 (Fig. 3). Electrofishing was not conducted at the sites in 1993, 1997 and 1999. The number of juvenile salmon at each site was determined by electrofishing using the depletion method (Zippen, 1958). Salmon that were not aged were apportioned into age categories based on an age-length key for fish that were sampled for fork length and age. Density of each age class was calculated using computer software developed by Van Deventer and Platts (1985). Age was determined from scale samples.

RESULTS

RECREATIONAL SALMON FISHERY

The recreational salmon fisheries on Lomond River and Torrent River opened 15 June and closed 7 September 2000. There were no in-season closures due to low water levels. Both the Lomond River and Torrent River were designated as Class II rivers under the new recreational salmon fishery management plan introduced in 1999. The retention limit on rivers in Class II was four small salmon for the season. This was the same as the total retention limit in 1998 but without the split season restrictions that were in place in 1994-98. With the split season, only one fish could be retained before 5 July and three after and anglers were required to release their catch before 5 July in order to continue fishing. Catch and effort statistics for 1974-2000 are given in Appendices 1-3. Effort values were not available from license stub returns for 1997-2000.

a) Lomond River

There was no individual river quota on Lomond River in 2000. The quota of 375 small salmon was removed in 1999, as it appeared to be no longer effective or necessary in controlling the catch on the river (Mullins et al., MS 1999). The retained catch of 263 and released catch of 64 small salmon in 2000 was 21% and 57% lower than in 1999, respectively. The total retained plus released catch of small salmon in 2000 was lowest since 1997 and since 1992, 22% lower than the 1992-96 mean. The retained catch of small salmon in 2000 was 31% higher than 1998 (the lowest since 1997), but the released catch of small salmon was 72% lower than 1998. The released catch of large salmon in 2000 was 89% lower than in 1999, 81% lower than the 1997-99 mean and 79%

lower than the 1992-96 mean. The released catch of large salmon in 2000 was the lowest on record since 1992.

In the first five years (1992-96) of the commercial salmon fishery moratorium, retained plus released catches of small and released catches of large salmon on Lomond River increased relative to pre-moratorium years (1984-91). Based on license stub return data, this continued in 1997-2000. However, it is noted that data for 2000 are preliminary.

b) Torrent River

The minimum spawning escapement of 750 salmon above the fishway before the start of the retention fishery was dropped in 1999 as this number of fish usually passed through the fishway within a few days (12 days in 1998) of the start of the run. The retained catch of 309 small salmon was about 35% lower than in 1999. The released catch of 332 small salmon was also 45% lower than 1999. The total retained plus released catch of small salmon was 41% less than in 1999. The released catch of large salmon was 68% less than in 1999.

During the first five years (1992-96) of the commercial salmon fishery moratorium, with the exception of 1994, retained plus released catches of small and large salmon on Torrent River were the highest since 1965. It appears that except for some slight fluctuation, this continued in 1997-2000. Catch per unit of effort (CPUE) also increased in the first two years of the moratorium but then decreased in 1994-96. This was due to an increase in angling effort in 1994-96 to nearly four times the effort in pre-moratorium years. However, it is noted that data for 2000 are preliminary.

c) Western Arm Brook

Angling was permitted on Western Arm Brook in 2000 for the purpose of biological sampling. The sampling was conducted from 8 July to 7 August. A total of 21 small salmon were retained, 15 above the fence and 6 below. Biological information, including internal sex and female gonads, were collected from all small salmon.

Data	Anglers with catch		Anglers without catch	Grand Total
	Above Fence	Below Fence		
Rod days	23	15	346	384
HOURS FISHED	51.2	35.6	730.8	817.6
Average HOURS FISHED	2.22	2.09	1.91	1.94
SMALL LOST	8	15	4	27
SMALL Retained	15	6		21
LARGE LOST		1	1	2
LARGE Released				

Sampling stopped on 7 August due to high water temperatures and low water levels and did not re-open. The target sample size of 1000 small salmon would not have been reached even if angling had continued until the end of the recreational season. The highest number of small salmon moving through the counting fence occurred during the same time as the biological sampling experiment. By 7 August, 80% of the small salmon had passed through the counting fence.

ADULT RETURNS

Dates of operation of the three counting facilities are given in Table 1. Operation of the fishways on Lomond River and Torrent River usually starts in mid to late June and the counting fence on Western Arm Brook is usually mid to late May depending on water levels and the timing of the spring thaw.

The daily counts of small and large salmon on Lomond River peaked in around the 21 July (Fig. 4). This was the latest of the three rivers. This may be due to the fact that the Lomond River facility is the farthest from the mouth of the river, although it is farther south. The daily counts at Torrent River and Western Arm Brook peaked one to two weeks earlier than Lomond River (Fig. 4). The highest daily counts on all three rivers occurred during the highest summer water levels (Fig. 4).

Run timing of small salmon on Lomond River and Torrent River in 2000 was similar to 1999 (Figs. 5-6). The run timing of large salmon was slightly earlier than in 1999 on Lomond River and slightly later on Torrent River (Figs. 5-6).

Run timing of small and large salmon on Western Arm Brook in 2000 was much earlier than in 1999 (Fig. 7).

Water levels on Western Arm Brook in 2000 were higher than in 1999 (Fig. 8) and may account for the earlier run timing in 2000 compared to 1999.

Total counts of small and large salmon at the three counting facilities are given in Table 2 and total returns are given in Table 3 and in Fig. 9.

Returns of small salmon to Lomond River were 21% lower than in 1999 and 10% lower than the 1992-99 mean (Fig. 9). Returns of large salmon were 33% lower than in 1999 and only slightly below the 1992-99 mean.

Returns of small salmon to Torrent River were 10% less than in 1999 and 14% less than the 1992-99 mean (Fig. 9). Returns of large salmon in 2000 were 43% and 28% higher than in 1999 and the 1992-99 mean, respectively.

Returns of small salmon to Western Arm Brook were 43% higher than in 1999 and 55% higher than the 1992-99 mean (Fig. 9). Returns of large salmon were five times higher than in 1999 and three times higher than the 1992-99 mean.

Returns of both small and large salmon to all three rivers were higher than the 1984-91 means indicating improvements in the stocks as a result of the commercial salmon fishery moratorium.

The proportion of small and large salmon in 2000 was based on counts at the three counting facilities. The proportion of small and large salmon on Lomond River was similar to 1999 (Table 4). The proportion of small salmon was slightly lower than in 1999 and compared to the 1992-99 means on Torrent River and Western Arm Brook and the proportion of large salmon was slightly higher. (Table 4).

SPAWNING ESCAPEMENTS AND POTENTIAL EGG DEPOSITIONS

Spawning escapements of small and large salmon are given in Table 5. Spawning escapements on all three rivers since 1992 have been above the 1984-91 means.

The results of biological sampling of small salmon conducted at Lomond River, Torrent River and Western Arm Brook in 2000 are given in Table 6. Where sample size was less than 30, data were pooled with previous years for estimation of egg deposition.

Pooled biological information used to estimate egg deposition for 2000 was as follows:
Lomond (small) - mean weight and percent female based on 1992-2000 mean.
Lomond (large) - mean weight females based on 1978-99 mean; percent female based on 1993.
Torrent (small) - mean weight and percent female based on 1992-2000 mean.
Torrent (large) - mean weight and percent female based on 1980-97 mean.
Western Arm (small) - mean weight and percent female based on 1992-2000 mean.
Western Arm (large) - mean weight and percent female based on 1992-99 mean.

River	Small salmon			Large salmon		
	Mean Wt. Females (kg)*	Fecundity	Prop. Female*	Mean Wt. Female (kg)*	Fecundity	Prop. Female*
Lomond River	1.58 (42)	2,817	0.586 (111)	3.62 (21)	6,454	0.857 (7)
Torrent River	1.79 (42)	3,192	0.588 (102)	4.04 (27)	7,203	0.638 (213)
Western Arm Brook	2.05 (123)	3,655	0.822 (157)	4.50 (59)	8,023	0.763 (80)

* Numbers in parentheses refer to pooled samples sizes.

Potential egg depositions and the percentage of conservation requirements achieved in 1984-2000 are given in Table 7. Conservation requirements above the counting facilities were exceeded on all three rivers in 2000 - 140%, 657% and 567%, on Lomond River, Torrent River and Western Arm Brook, respectively. The percentage achieved decreased on Lomond River and Torrent River but increased on Western Arm Brook in comparison to 1999.

It is recognised that the total potential egg depositions estimated for Lomond River, Torrent River and Western Arm Brook are based on point estimates of the number of eggs deposited per small and large salmon. There is a degree of uncertainty associated with these point estimates because the values for the mean weight of females, the percentage female and the relative fecundity that were used to derive them were also estimated based on sampling programs. The results of recalculations of egg depositions using 20% coefficient of variation for these parameter values, indicated that a wide range of egg depositions were possible on each of the rivers (Fig. 10). Out of 5000 calculations, the egg deposition with the highest frequency of occurrence was the one represented by the point estimate for each river. Calculation of the probability associated with each of the calculations revealed that there was a very low probability that the conservation requirement on any of the three rivers was not achieved in 2000 (Fig. 10).

WESTERN ARM BROOK SMOLTS COUNTS AND SURVIVAL

a) Smolt Counts

The smolt production of 12,706 recorded at Western Arm Brook in 2000 was 6% less than in 1999, 17% less than the 1992-99 mean, and 15% less than the 1984-91 mean (Table 8; Fig. 11).

The results of biological sampling indicate that the mean fork length, whole weight and overall condition of smolts in 2000 were only slightly higher than in 1999 (Fig. 12). This is reflective of better growth of juvenile fishes in freshwater and should indicate a good potential for marine survival. The age of

smolts in 2000 was predominantly four years old (Fig. 13). This is the same as most years in the past. Based on an age of four years, these smolts were from the 1995 spawning year-class.

The highest number of smolts counted in recent years was in 1997 (Fig. 11), five years after the commercial salmon fishery moratorium in 1992. If the average smolt age is four years, the majority of those smolts were from the 1992 spawning year-class. However, that year-class was among the lowest recorded on the river (Table 7). This may have been due to the fact that, in spite of the commercial salmon fishery moratorium, there was still a potential for high by-catch of salmon in cod fishing gear. With the implementation of the commercial cod fishery moratorium in 1993, spawning escapements and egg depositions increased in 1993 and 1994. These two larger year-classes would have contributed 2 and 3-year old smolts, respectively, to the high smolt production in 1997.

The higher spawning year-classes in years subsequent to 1993 and 1994 did not continue to produce increased overall smolt production. Smolt production values in 1998-2000 were all lower than in 1997.

b) Egg-to-Smolt Survival

Egg-to-smolt survival is represented by smolt production at the counting fence on Western Arm Brook adjusted to the year at egg. In general, smolt production has tended to be more variable at higher potential egg depositions (Fig. 14). Assuming that potential egg deposition reflects the number of eggs that were actually spawned, this result is suggestive of some density dependent mortality - perhaps on the spawning grounds or of juvenile fish. Based on an average smolt age of four years, the majority of smolts in 2000 were from the 1995 spawning year-class. Total egg depositions in 1995 was similar to 1993 and 1994 (Table 7) but with wide variation in subsequent smolt production (Fig. 14).

The potential egg deposition in 1996 was the highest recorded to-date since 1992. Assuming similar smolt age distribution to previous years, the 1996 year-class will contribute the dominant 4-year old age-class to the smolt production on 2001. Therefore, it is expected that smolt production in 2001 will be higher than in 2000. However, based on the high variability of smolt production at high egg depositions, future smolt production is highly unpredictable.

c) Marine Survival

Assuming that the sea-age distribution of adult salmon in 2000 was the same as in previous years, the marine survival of smolts that returned to the river as 1SW salmon in 2000 was 11.0% (Table 8; Fig. 15). This was the second

highest since 1971 and was 80% higher than in 1999 and 57% higher than the 1992-99 mean (Table 8).

With the exception of 1997, when marine survival was among the lowest recorded, the marine survival of smolts at Western Arm Brook has increased overall since 1992 compared to the 1984-91 mean (Table 8; Fig. 15). This change can be attributed to the absence of commercial salmon exploitation since 1992. However, adjusting the marine survival in 1972-91 for commercial exploitation, suggests that marine survival has tended to decline over the long term (Fig. 15). Marine survival in 1992-2000, while increasing somewhat as a result of the closure of the commercial salmon fishery, has remained relatively low in comparison to the long term (Fig. 15). This highlights the fact that factors other than commercial exploitation play an important role in the survival of salmon in the marine environment and that these factors are not static and that some may have increased in their influence in recent years.

The run timing of smolts at Western Arm Brook was mid-June 2000 (Fig. 16). This was about average since 1971 but much later than that recorded in 1998 and 1999 (Fig. 16). The earliest run timing was early June in 1979.

The mean water temperatures at the counting fence and in the estuary at the time of the smolt run were lower in 2000 than in recent years but the of temperature on smolt survival is unknown at this point. The mean water temperature at the counting fence in June 2000 was lower than in 1998 and 1999 but was higher than the 1992-99 and 1984-91 means (Fig. 17a). The mean water temperature in the estuary in June 2000 was lower than 1998 and 1999 (Fig 17b).

d) Anticipated Returns in 2001

It was expected that the returns of adult small salmon to Western Arm Brook in 2000 would be 21% lower in 1999 (Mullins and Caines, 2000) based on a marine survival of 6.1% experienced in 1999. However, the high marine survival in 2000 resulted in returns that were 80% higher than expected.

Assuming that marine survival in 2001 will be the same as for 2000 (11.0%), it is expected that approximately 1,398 small salmon will return to Western Arm Brook in 2001. This would be 6% less than in 2000. If marine survival is actually closer to the mean in recent years (7.0%) the return will be only about 889 small salmon, about 40% less than in 2000.

The difference between expected and actual returns based on this method has been highly variable because of the instability in marine survival. However, the differences were positive in six out of nine years indicating higher than expected survival.

Year (*i*)	Smolts (*i*-1)	Expected	Observed	% Difference.
1992	13453	297	479	+61
1993	15405	550	817	+49
1994	13435	826	919	+11
1995	9283	659	823	+25
1996	15144	1342	1230	-8
1997	14502	1218	429	-65
1998	23845	715	1581	+121
1999	17139	1131	1044	-8
2000	13500	823	1489	+81
2001	12706	1398		

The maximum negative difference in expected returns was 65% in 1997. If this were the case in 2001, assuming no recreational harvests, spawning escapements would not produce sufficient egg deposition on Western Arm Brook to achieve the conservation requirement. If a recreational harvest was to be permitted on Western Arm Brook, it should only be after sufficient spawning escapements have entered the river to achieve the conservation requirement.

NET MARKS AND SCARS

Incidence of marking and scarring observed at Lomond River and Torrent River in 2000 decreased on small salmon but increased for large salmon compared to 1999 (Table 9). At Western Arm Brook the opposite situation was observed. Some of the marking observed at Lomond and Torrent River may be due to injuries obtained from jumping at the falls. It is cautioned that while incidence of marking and scarring does indicate an encounter with predators or foreign objects as well as potential mortality, it does not necessarily mean more salmon lost to illegal activity as some legally set fishing gear may also temporarily trap salmon as by-catch. Increased marking may also indicate lower as opposed to higher netting efficiency of illegal gear. For example, netting efficiency may be related to water conditions in the river resulting in increased escapement from nets under certain conditions.

BIRD PREDATION

Bird observations were carried out at the counting fence and in the estuary from 16 May until 3 July 2000. A total of 517 observations were made – 400 in the estuary and 117 in the river at the counting fence. With few exceptions, the species observed in 1998 were again observed in 2000 (Table 10). Herring gulls were observed most often at both locations in 2000 as in 1998. Other known fish predators such as the Osprey and Merganser were only observed in the estuary. Herring Gulls were also the most numerous in 2000 as in 1998 (Table 11). In 2000 and 1998 there were few observations of birds feeding on fish (Table 12). No smolts were observed as prey in 2000. Of the commonly known fish

predators only the Kingfisher was present throughout the smolt run in 2000 (Fig. 18). This was a change from 1998 when loons were present throughout the run (Mullins et al. MS 1999). More information on the residence time of smolts in the estuary as well as their contribution to the diet of predators are needed to fully evaluate the influence of bird predation on smolt survival.

JUVENILE DENSITIES

The density of salmon fry (age 0+) at the three sites surveyed on Western Arm Brook in 2000 showed an increase compared to 1998 (Fig. 19a). Site 3 had the highest density in 2000. This may be related to redistribution of spawning.

The density of salmon parr (age 1+& up) at all three sites declined in 2000 compared to 1998 (Fig 19b). Prior to 2000, there appeared to be an increasing trend of parr density at the three sites since 1992 (Mullins et al, 1999). The change in 2000 may have been a result of redistribution within the river but may also be related to the lower juvenile survival in recent years.

DISCUSSION

Salmon stocks on Lomond River, Torrent River and Western Arm Brook exceeded conservation requirements in 2000, as in every year since 1992. This was due to increased spawning escapements of small and large salmon and increased proportion of large salmon compared to the 1984-91 means. These increases can be attributed to the closure of the commercial salmon fishery in 1992 and to the reduction of salmon by-catch with the closure of the commercial cod fishery since 1993, especially for Lomond River and Western Arm Brook. The salmon stock on Torrent River would also have benefited from these closures but improvements since the 1970s can also be attributed to the successful colonisation of a major portion of the watershed with adult salmon and possibly with an early high survival of juvenile salmon in the freshwater environment.

The continued higher spawning escapements in recent years, especially of large salmon, afforded by the closure of commercial salmon and cod fisheries suggests a potential for continued future growth in all three of these stocks. However, considering the low egg to smolt survival, low juvenile densities and unexpectedly low marine survival recorded at Western Arm Brook such as in 1997, compared to years when commercial fisheries were in place, future improvements are by no means assured. In fact, when marine survival prior to 1992 is adjusted for commercial exploitation, it is clear that there has been a continued decline in marine survival in recent years. This decline is not unique to Western Arm Brook and the factors contributing to such a decline are currently unknown (CSAS, 1998). However, the fact highlights the need for further

investigation and for caution in the management of fisheries harvests. In spite of recent improvements in the status of these stocks, there is still a need to manage fisheries in such a way that the most productive spawning levels are maintained.

There is also reason to be cautious in the interpretation of stock assessment results. In particular, the annual variability in the effect of atresia on fecundity (O'Connell et al., MS 1997) and the potential for spawner mortality upstream of counting facilities as well as other egg losses in the river result in estimates of egg deposition that should be treated as potential only. The fecundity values used to calculate egg depositions for all three rivers were based on biological characteristics of Western Arm Brook salmon in 1979-80 (Chadwick et al., 1986). Ideally, fecundity estimates should be revised for each of these rivers, given the potential for change in the body size of returning adults as a result of the moratorium. O'Connell and Dempson (1995) discuss in detail cautions associated with estimates of parameter values used to calculate conservation requirements. Some of the uncertainty created by these estimates has been incorporated into the calculation of egg deposition using simulation techniques. It is encouraging that even with this uncertainty included it was highly unlikely that the conservation requirements on these rivers would not have been achieved in 2000.

The habitat measurements on which conservation requirements are based were taken from aerial surveys conducted in the early 1970s (Traverse, 1971). These measurements should be verified and updated based on currently available digitised maps. Until this work is completed, habitat estimates should be viewed as minimum values.

Both Lomond River and Torrent River currently support recreational salmon fisheries while continuing to exceed conservation requirements. Currently fisheries are not permitted upstream of the fishways on these two rivers. It is recommended that this restriction remain in place until habitat estimates can be reviewed. An upward revision of habitat estimates could result in an increase in the conservation requirements for these rivers. Given the improvements observed in the salmon stocks on these three rivers and the added control afforded by the introduction of the river classification system in 1999, there may be opportunities for increased harvests below, rather than above, counting facilities. However, given the variability in marine survival observed for Western Arm Brook it is cautioned that harvests on this river in particular, should not be permitted until the conservation requirement has been achieved.

In addition, because of the long time series of salmon data available from counting facilities on Lomond River, Torrent River and Western Arm Brook, there exists a rare opportunity to monitor changes in the stocks relative to pre-moratorium years. This can be done by studying the relationship between the number of spawners and recruits and between egg deposition and smolt

production. This can only be accomplished if counting facilities remain in place to monitor returns to the rivers and if there is an accurate accounting of removals in order to determine spawning escapements. Currently spawning escapements on these three rivers are known because angling is not permitted above counting facilities. It is recommended that fisheries not be supported above these facilities unless the angling catch can be accurately determined.

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Table 1. Dates of operation of counting facilities at Lomond River, Torrent River and Western Arm Brook, 1971-2000.

Year	Lomond River	Torrent River	Western Arm Brook
1971	26 June to 25 September	5 June to 23 October	14 May to 28 September
1972	8 July to 16 September	11 June to 11 November	27 May to 22 September
1973	16 July to 8 September	23 June to 4 November	25 May to 17 September
1974	6 July to 7 September	8 June to 16 November	1 June to 24 August
1975	7 June to 16 August	29 June to 11 October	23 May to 6 October
1976	12 June to 28 August	3 July to 23 October	19 May to 25 September
1977	2 July to 10 September	2 July to 1 October	16 May to 23 October
1978	1 July to 29 September	4 June to 11 November	25 May to 31 December
1979	23 June to 8 September	30 June to 3 November	25 May to 23 September
1980	28 June to 13 September	28 June to 11 October	26 May to 12 October
1981	20 June to 5 September	20 June to 5 September	14 May to 9 September
1982	26 June to 11 September	28 June to 2 October	1 June to 27 September
1983	1 July to 28 August*	23 June to 21 October	11 May to 27 October
1984	21 June to 1 November	25 June to 29 October	24 May to 26 October
1985	11 June to 29 October	12 June to 31 October	5 June to 30 October
1986	6 June to 4 October	24 June to 1 October	14 May to 25 October
1987	**	3 June to 9 October	13 May to 27 October
1988	**	22 June to 5 October	19 May to 31 October
1989	**	26 June to 20 September	19 May to 17 October
1990	**	4 July to 19 October	25 May to 24 October
1991	**	26 June to 22 October	29 May to 28 October
1992	15 June to 25 September	1 July to 23 September	28 May to 19 October
1993	29 June to 25 September	28 June to 12 October	31 May to 19 October
1994	24 June to 28 October	18 July to 24 October	27 May to 24 October
1995	12 July to 23 September	16 July to 1 November	26 May to 29 September
1996	19 June to 18 November	19 June to 31 October	3 May to 27 September
1997	28 June to 20 October	17 June to 7 November	13 May to 2 October
1998	23 June to 10 October	17 June to 9 October	6 May to 24 September
1999	15 June to 29 September	16 June to 14 October	13 May to 30 September
2000	22 June to 23 October	16 June to 23 October	12 May to 28 September

* Fishway operational but fish not counted after 28 August.

** Fishway operational but dates not available.

Table 2. Counts of small and large Atlantic salmon at counting facilities on Lomond River, Torrent River and Western Arm Brook, 1974-2000. Numbers in bold are partial counts.

	Lomond River		Torrent River		Western Arm Brook		
					Unadjuste	Adjusted	
Year	Small	Large	Small	Large	Small	Small	Large
1971	6	0	54	4	427	.	305
1972	30	15	64	3	309	.	9
1973	108	110	96	12	554	.	30
1974	41	33	38	3	382	.	4
1975	**1**	**0**	191	25	631	.	1
1976	132	11	341	47	520	.	0
1977	192	11	789	33	362	.	3
1978	117	12	971	21	293	.	1
1979	195	1	1984	39	1578	.	0
1980	301	19	792	63	435	.	3
1981	110	50	2101	97	451	.	1
1982	275	16	2112	523	394	.	3
1983	220	7	2007	442	1141	.	4
1984	440	47	1805	288	120	.	0
1985	190	14	1553	30	**165**	416	1
1986	354	32	2815	92	**252**	525	0
1987	355	11	2505	68	378	.	1
1988	437	21	2075	44	**102**	251	1
1989	**382**	**21**	1369	60	**414**	455	0
1990	**391**	**18**	2296	82	**124**	444	0
1991	**403**	**20**	1441	71	233	.	1
1992	435	80	2347	169	480	.	8
1993	526	34	4009	222	947	.	8
1994	701	50	3592	331	954	.	31
1995	1003	95	5800	611	823	.	33
1996	601	93	6923	507	1230	.	50
1997	783	72	3659	666	509	.	55
1998	542	126	4999	757	1718	.	128
1999	829	113	4008	399	1046	.	22
2000	658	81	3763	587	1486	.	120
Mean (92-99)	678	83	4417	458	963	.	42
95% CL=+/-	157	26	1199	178	333	.	32
CV	27.7	37.1	32.5	46.5	41.3	.	92.7
N	8	8	8	8	8	.	8
Mean (84-91)	369	23	1982	92	224	.	1
95% CL=+/-	66	10	442	68	100	.	0
CV	21.5	49.9	26.7	88.9	53.4	.	106.9
N	8	8	8	8	8	.	8

Note: Western Arm Brook small salmon counts in some years were adjusted to account for fish that did not move upstream until after the counting fence was removed:

1. small salmon counts in 1985-88 were adjusted based on the ratio of marked to unmarked small at the counting fence (Claytor and Mallins, 1988).
2. small salmon count in 1989 was adjusted based on kelt counts in 1989.
3. small salmon count in 1990 was adjusted based on the proportion of marked kelts (131/144) recaptured in 1990.
4. small salmon count in 1990 was adjusted based on the proportion of marked kelts (43/154) recaptured in 1991.

Table 3. Total returns of small and large Atlantic salmon to Lomond River, Torrent River and Western Arm Brook, 1971-2000.

Year	Lomond River		Torrent River		Western Arm Brook	
	Small	Large	Small	Large	Small	Large
1971*	60	1	107	9	632	305
1972	283	50	86	6	406	9
1973	394	165	184	15	797	30
1974	365	52	96	7	506	4
1975	259	20	314	31	639	1
1976	782	36	341	47	552	0
1977	687	45	789	33	373	3
1978	462	41	1002	25	315	2
1979	430	3	2049	42	1578	0
1980	594	32	792	63	465	5
1981	617	53	2268	115	492	1
1982	583	23	2299	525	467	3
1983	471	10	2089	443	1141	4
1984	986	75	1805	288	235	0
1985	393	14	1623	30	467	1
1986	725	37	3155	93	527	0
1987	652	12	2670	68	437	1
1988	841	24	2388	44	422	1
1989	652	22	1512	60	455	0
1990	777	19	2518	82	444	0
1991	731	21	1591	71	233	1
1992	794	86	2832	170	480	8
1993	816	38	4215	224	947	8
1994	1038	56	3827	332	954	31
1995	1365	101	6168	615	823	33
1996	982	98	7371	509	1230	50
1997	1300	77	4033	674	509	55
1998	766	128	5329	766	1718	128
1999	1179	123	4545	416	1046	22
2000	927	82	4105	593	1492	120
Mean (92-99)	1030	88	4790	463	933	42
95% CL=+/-	195	26	1207	180	333	32
CV	22.7	35.2	30.1	46.5	41.3	92.7
N	8	8	8	8	8	8
Mean (84-91)	720	28	2158	92	403	1
95% CL=+/-	143	17	508	68	91	0
CV	23.8	72.7	28.2	88.8	27.0	107.5
N	8	8	8	8	8	8

* Incorrect sizing suspected at Western Arm Brook (Moores and Ash, 1984)

Table 4. Proportion of small and large Atlantic salmon observed at counting facilities on Lomond River, Torrent River and Western Arm Brook, 1971-2000.

Year	Lomond River		Torrent River		Western Arm Brook	
	Small	Large	Small	Large	Small	Large
1971	1.00	0.00	0.93	0.07	0.58	0.42
1972	0.67	0.33	0.96	0.04	0.97	0.03
1973	0.50	0.50	0.89	0.11	0.95	0.05
1974	0.55	0.45	0.93	0.07	0.99	0.01
1975	1.00	0.00	0.88	0.12	1.00	0.00
1976	0.92	0.08	0.88	0.12	1.00	0.00
1977	0.95	0.05	0.96	0.04	0.99	0.01
1978	0.91	0.09	0.98	0.02	1.00	0.00
1979	0.99	0.01	0.98	0.02	1.00	0.00
1980	0.94	0.06	0.93	0.07	0.99	0.01
1981	0.69	0.31	0.96	0.04	1.00	0.00
1982	0.95	0.05	0.80	0.20	0.99	0.01
1983	0.97	0.03	0.82	0.18	1.00	0.00
1984	0.90	0.10	0.86	0.14	1.00	0.00
1985	0.93	0.07	0.98	0.02	1.00	0.00
1986	0.92	0.08	0.97	0.03	1.00	0.00
1987	0.97	0.03	0.97	0.03	1.00	0.00
1988	0.95	0.05	0.98	0.02	1.00	0.00
1989	0.95	0.05	0.96	0.04	1.00	0.00
1990	0.96	0.04	0.97	0.03	1.00	0.00
1991	0.95	0.05	0.95	0.05	1.00	0.00
1992	0.84	0.16	0.93	0.07	0.98	0.02
1993	0.94	0.06	0.95	0.05	0.99	0.01
1994	0.93	0.07	0.92	0.08	0.97	0.03
1995	0.91	0.09	0.90	0.10	0.96	0.04
1996	0.87	0.13	0.93	0.07	0.96	0.04
1997	0.92	0.08	0.85	0.15	0.90	0.10
1998	0.81	0.19	0.87	0.13	0.93	0.07
1999	0.88	0.12	0.91	0.09	0.98	0.02
2000	0.89	0.11	0.87	0.13	0.93	0.07
Mean (92-99)	0.89	0.11	0.91	0.09	0.96	0.04
95% CL=+/-	0.04	0.04	0.03	0.03	0.02	0.02
CV	5.1	40.5	3.8	36.8	3.1	74.0
N	8	8	8	8	8	8
Mean (84-91)	0.94	0.06	0.96	0.04	1.00	0.00
95% CL=+/-	0.02	0.02	0.03	0.03	0.00	0.00
CV	2.4	38.2	4.1	86.3	0.2	113.1
N	8	8	8	8	8	8

Table 5. Spawning Escapements of small and large Atlantic salmon on Lomond River,Torrent River and Western Arm Brook, 1971-2000. Spawners on Torrent in 1972-76 include surviving spawners transferred from Western Arm Brook (60, 206, 83, 223, 100).

Year	Lomond River		Torrent River		Western Arm Brook	
	Small	Large	Small	Large	Small	Large
1971	6	0	54	4	427	305
1972	30	15	120	3	249	9
1973	108	110	299	12	348	30
1974	41	33	121	3	299	4
1975	1	0	404	25	285	1
1976	132	11	441	47	365	0
1977	192	11	789	32	352	3
1978	117	12	971	21	289	1
1979	195	1	1,984	39	1,578	0
1980	301	19	789	63	427	3
1981	110	50	2,101	97	447	1
1982	275	16	2,112	523	391	3
1983	220	7	2,007	442	1,140	4
1984	440	47	1,805	288	117	0
1985	189	14	1,551	30	416	1
1986	353	32	2,815	92	525	0
1987	355	11	2,482	68	378	1
1988	437	21	2,075	44	251	1
1989	382	21	1,367	60	455	0
1990	391	18	2,296	82	444	0
1991	403	20	1,440	71	233	1
1992	419	80	2,344	169	480	8
1993	504	33	4,009	222	947	8
1994	695	49	3,592	331	954	31
1995	983	95	5,800	611	796	30
1996	601	93	6,923	507	1,189	48
1997	783	72	3,659	666	508	55
1998	541	125	4,999	757	1,650	128
1999	819	110	4,008	399	1,045	22
2000	655	81	3,762	587	1,468	120
Mean (92-99)	668	82	4417	458	946	41
95% CL=+/-	157	26	1200	178	339	32
CV	28.0	37.2	32.5	46.5	39.9	94.2
N	8	8	8	8	8	8
Mean (84-91)	369	23	1979	92	352	1
95% CL=+/-	67	10	440	68	115	0
CV	21.6	49.9	26.6	88.9	39.2	106.9
N	8	8	8	8	8	8

Table 6. Biological characteristics of smolt and small salmon on Lomond River, Torrent River, and Western Arm Brook, 2000.

River			Forklength (cm)		Female Whole Weight (kg)		Male Whole Weight (kg)		Female		Riverage	
			N	Mean	N	Mean	N	Mean	N	Percent	N	Mean
Lomond	Small salmon	Internally sexed			1	1.20	1	1.50	3	60.0		
		Externally sexed			2	1.50			6	100.0		
		Total	11	54.95	3	1.40	1	1.50			10	3.00
Torrent	Smolt	Internally sexed	42	15.48	28	34.72	14	31.00	28	66.7	42	3.38
	Small salmon	Internally sexed			12	1.83	16	1.94	18	36.0		
		Externally sexed			2	2.15	3	1.83	2	40.0		
		Total	42	56.24	14	1.88	19	1.92			41	3.22
Western Arm	Smolt	Internally sexed	125	17.46	92	47.17	30	47.93	92	73.6	125	3.69
	Small salmon	Internally sexed	24	55.00	19	1.86	5	1.92	24	79.2	23	3.87

Table 7. Total returns, spawning escapement, potential egg deposition and percentage of egg deposition requirement achieved by small and large Atlantic salmon on Lomond River, Torrent River, and Western Arm Brook, 1984-2000. Numbers in bold type were estimated based on partial counts.

	Total Returns		Spawning Escapement		No. Eggs x 10^6			% Eggs Achieved*	
Year	Small	Large	Small	Large	Small	Large	Total	Small+Large	Small
Lomond River (CR=1,095,200)									
1984	986	75	440	47	0.7356	0.0758	0.8114	74	67
1985	393	14	189	14	0.3160	0.0226	0.3385	31	29
1986	725	37	353	32	0.5901	0.0516	0.6417	59	54
1987	652	12	355	11	0.5935	0.0177	0.6112	56	54
1988	841	24	437	21	0.7306	0.0339	0.7644	70	67
1989	**652**	**22**	382	21	0.6386	0.0339	0.6725	61	58
1990	777	**19**	391	18	0.6537	0.0290	0.6827	62	60
1991	731	21	403	20	0.6737	0.0323	0.7060	64	62
1992	794	86	419	80	0.9495	0.3728	1.3223	121	87
1993	816	38	504	33	1.1421	0.1538	1.2959	118	104
1994	1038	56	695	49	1.2714	0.2793	1.5507	142	116
1995	1365	101	983	95	1.5115	0.5415	2.0530	187	138
1996	982	98	601	93	1.0414	0.5244	1.5658	143	95
1997	1300	77	783	72	1.3568	0.4060	1.7627	161	124
1998	766	128	541	125	0.9450	0.7048	1.6498	151	86
1999	1179	123	819	110	1.3629	0.6202	1.9831	181	124
2000	927	82	655	81	1.0813	0.4567	1.5380	140	99
Torrent River (CR=1,484,235)									
1984	1805	288	1,805	288	3.0902	0.9118	4.0020	270	282
1985	1623	30	1,551	30	2.3022	0.0909	2.3932	161	210
1986	3155	93	2,815	92	4.9539	0.3913	5.3452	360	452
1987	2670	68	2,482	68	2.7027	0.2486	2.9513	199	247
1988	2388	44	2,075	44	3.8292	0.1130	3.9422	266	350
1989	1512	60	1,367	60	3.1478	0.1874	3.3352	225	287
1990	2518	82	2,296	82	3.0851	0.1993	3.2843	221	282
1991	1591	71	1,440	71	2.4155	0.2295	2.6450	178	221
1992	2832	170	2,344	169	4.1125	0.5364	4.6489	313	376
1993	4215	224	4,009	222	7.2739	0.7046	7.9784	538	684
1994	3827	332	3,592	331	6.2796	1.5815	7.8611	530	573
1995	6168	615	5,600	611	12.4117	2.9193	15.3310	1033	1133
1996	7371	509	6,923	507	16.4851	2.4955	18.9807	1279	1505
1997	4033	674	3,659	666	8.7749	3.0607	11.8357	797	801
1998	5329	766	4,999	757	10.2389	3.4790	13.7178	924	935
1999	4545	416	4,008	399	8.2555	1.8337	10.0892	680	754
2000	4105	593	3,762	587	7.0599	2.6977	9.7576	657	645
Western Arm Brook (CR=907,788)									
1984	235	0	117	0	0.2746	0.0000	0.2746	30	25
1985	**487**	1	416	1	0.7202	0.0017	0.7219	80	66
1986	**527**	0	525	0	1.4194	0.0000	1.4194	156	130
1987	437	1	378	1	0.9297	0.0025	0.9322	103	85
1988	422	1	251	1	0.6051	0.0024	0.6075	67	55
1989	**455**	0	455	0	1.2907	0.0000	1.2907	142	118
1990	444	0	444	0	1.4276	0.0000	1.4276	157	130
1991	233	1	233	1	0.6129	0.0026	0.6155	68	56
1992	480	8	480	8	1.3454	0.0224	1.3678	151	123
1993	947	8	947	8	2.5943	0.0219	2.6163	288	237
1994	954	31	954	31	2.5321	0.1187	2.6507	292	231
1995	823	33	796	30	2.3844	0.2122	2.5966	286	218
1996	1230	50	1,189	48	3.4858	0.2839	3.7696	415	318
1997	509	55	508	55	1.4985	0.3167	1.8152	200	137
1998	1718	128	1,650	128	4.9381	0.7337	5.6718	625	451
1999	1046	22	1,045	22	3.2205	0.1347	3.3552	370	294
2000	1492	120	1,468	120	4.4107	0.7346	5.1453	567	403

* % conservation requirement is calculated based on eggs from small + large salmon combined and based on eggs from small salmon only.

Notes:

1. Lomond egg depositions in 1984-88 is based on 1983-93 mean biological characteristics and 1992-93 based on 1993 values.
2. Torrent egg depositions in 1990-93 based on 1985-89 mean biological characteristics for 1985-89 for small and large salmon.
3. Western Arm Brook egg depositions in 1984 based on 1974-93 mean biological characteristics for small and large salmon combined.

Table 8. Marine survival of Atlantic salmon smolts to returning adults at Western Arm Brook, 1971-2000.

Smolt Year (i)	Smolts Year (i)	Small Returns Year (i+1)			
		Small Returns Year (i+1)	% Virgin 1SW	V. 1SW Returns Year (i+1)	% Sea-Survival
1971	5735	406	95.9	389	6.8
1972	11905	797	99.6	794	6.7
1973	8484	506	100.0	506	6.0
1974	11854	639	100.0	639	5.4
1975	9600	552	100.0	552	5.8
1976	6232	373	100.0	373	6.0
1977	9899	315	97.7	308	3.1
1978	13071	1578	99.6	1572	12.0
1979	8349	465	100.0	465	5.6
1980	15665	492	97.0	477	3.0
1981	13981	467	100.0	467	3.3
1982	12477	1141	99.5	1135	9.1
1983	10552	235	100.0	235	2.2
1984	20653	467	98.8	462	2.2
1985	13417	527	100.0	527	3.9
1986	17719	437	100.0	437	2.5
1987	17029	422	84.1	355	2.1
1988	15321	455	100.0	455	3.0
1989	11407	444	97.9	435	3.8
1990	10563	233	100.0	233	2.2
1991	13453	480	99.8	479	3.6
1992	15405	947	86.3	817	5.3
1993	13435	954	96.3	919	6.8
1994	9283	823	100.0	823	8.9
1995	15144	1230	100.0	1230	8.1
1996	14502	509	84.3	429	3.0
1997	23845	1718	92.0	1581	6.6
1998	17139	1046	99.8	1044	6.1
1999	13500	1492	99.8	1489	11.0
2000	12706				
Mean (92-99)	15282	1090	95	1041	7.0
95% CI +/-	3462	320	5	318	2.0
C.V.	27.1	35.1	6.9	36.6	34.7
N	8	8	8	8	8
Mean (84-91)	14945	433	98	423	2.9
95% CI +/-	2845	73	5	76	0.6
C.V.	22.8	20.1	5.6	21.4	26.3
N	8	8	8	8	8

Table 9. Incidence of net marks and scarring observed on small and large Atlantic salmon at counting facilities on Lomond River, Torrent River, and Western Arm Brook, 1999-2000.

River	No. Checked		No. Net Marks		No. Scars		% Net Marks		% Scars		Total % Marked	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Lomond												
1999	717	94	11	1	11	3	1.5	1.1	1.5	3.2	3.1	4.3
2000	658	81	1	6	0	9	0.2	7.4	0.0	11.1	0.2	18.5
Torrent												
1999	4004	399	1	0	9	2	0.0	0.0	0.2	0.5	0.2	0.5
2000	3763	586	1	0	24	5	0.0	0.0	0.6	0.9	0.7	0.9
WAB												
1999	1046	22	1	0	0	2	0.1	0.0	0.0	9.1	0.1	9.1
2000	1486	120	4	1	2	1	0.3	0.8	0.1	0.8	0.4	1.7

Table 10. Frequency of occurrence of bird species observed at Western Arm Brook, 1998 and 2000.

No. of Sightings	Location Name	Year		
	Estuary		River	
Bird Name	1998	2000	1998	2000
American Bittern	1		4	2
Bald Eagle	1			
Belted Kingfisher		3		6
Black Duck	8	12		2
Canada Goose	42	19		
Crow	14	41	8	3
Duck (unsp)	19	3		
Golden Eye		34		
Gr. Scaup	29			
Great Yellow Leg		13		
Green Wing Teal		2		
Gull (Black Back)	36	49		
Gull (Herring)	117	97	71	21
Gull (Ring-billed)		8		
Lesser Yellow Legs	4			
Loon	8	6	1	
Merganser	25			
Merganser (Common)		42		
Merganser (Red Breasted)		9		
Osprey	21	6	7	3
Pintail Duck	11			
Raven		2		
Sandpiper		6		
Teal	1			
Tern (Arctic)	1			
Tern (Common)	32	44		
Unknown			1	
Grand Total	370	396	92	37

Table 11. Bird counts at Western Arm Brook, 1998 and 2000.

No. of Birds	Location Name	Year		
	Estuary		River	
Bird Name	1998	2000	1998	2000
American Bittern	1	0	5	2
Bald Eagle	1	0	0	0
Belted Kingfisher	0	3	0	7
Black Duck	52	33	0	3
Canada Goose	897	386	0	0
Crow	19	65	9	3
Duck (unsp)	95	4	0	0
Golden Eye	0	333	0	0
Gr. Scaup	280	0	0	0
Great Yellow Leg	0	23	0	0
Green Wing Teal	0	3	0	0
Gull (Black Back)	51	92	0	0
Gull (Herring)	513	453	88	43
Gull (Ring-billed)	0	36	0	0
Lesser Yellow Legs	4	0	0	0
Loon	11	28	1	0
Merganser	173	0	0	0
Merganser (Common)	0	400	0	0
Merganser (Red Breasted)	0	24	0	0
Osprey	25	7	9	3
Pintail Duck	31	0	0	0
Raven	0	2	0	0
Sandpiper	0	8	0	0
Teal	5	0	0	0
Tern (Arctic)	3	0	0	0
Tern (Common)	94	332	0	0
Unknown	0	0	1	0
Grand Total	2255	2232	113	61

Table 12. Incidence of food types of birds observed feeding in 1998 and 2000.

Food Types	YY	Food Name							
	1998			1998 Total	2000			2000 Total	Grand Total
Bird Name	Smolt	Flounder	Smolt/Smelt		Eel Grass	Fish	Unidentified		
Bald Eagle	0	1	0	1	0	0	0	0	1
Canada Goose	0	0	0	0	1	0	1	2	2
Crow	0	0	0	0	0	1	0	1	1
Gull (Black Back)	0	1	0	1	0	0	0	0	1
Gull (Herring)	0	0	0	0	0	1	2	3	3
Merganser	0	0	1	1	0	0	0	0	1
Osprey	0	1	0	1	0	0	2	2	3
Tern (Common)	0	0	0	0	0	1	1	2	2
Grand Total	0	3	1	4	1	3	6	10	14

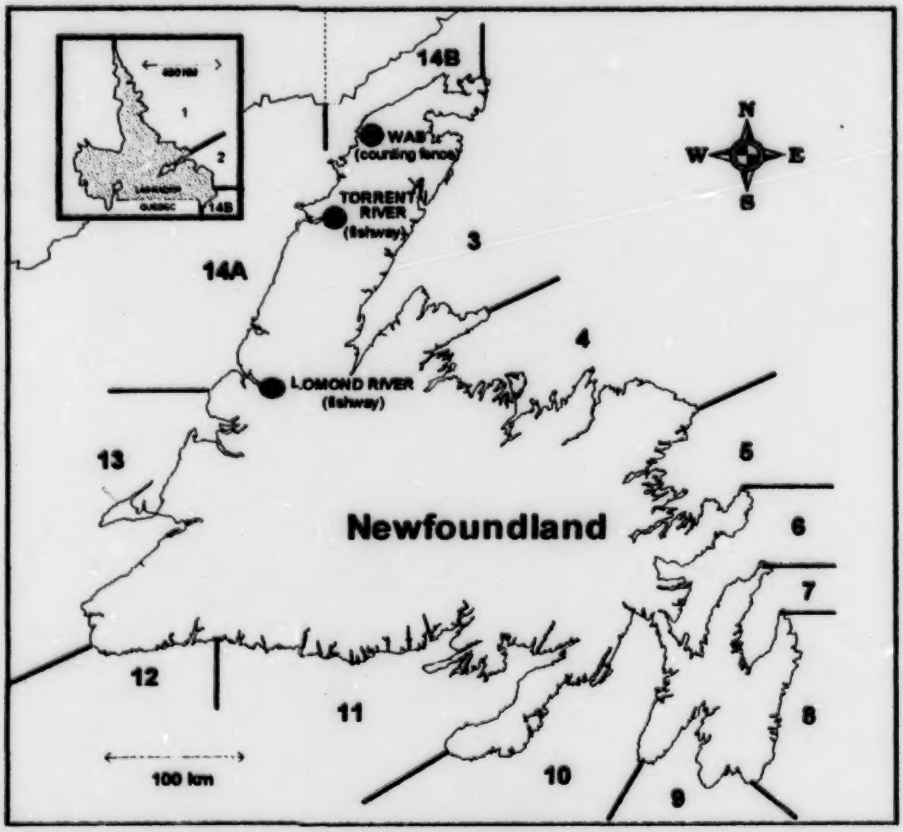


Figure 1. Salmon Fishing Areas (SFAs) of Newfoundland and Labrador.

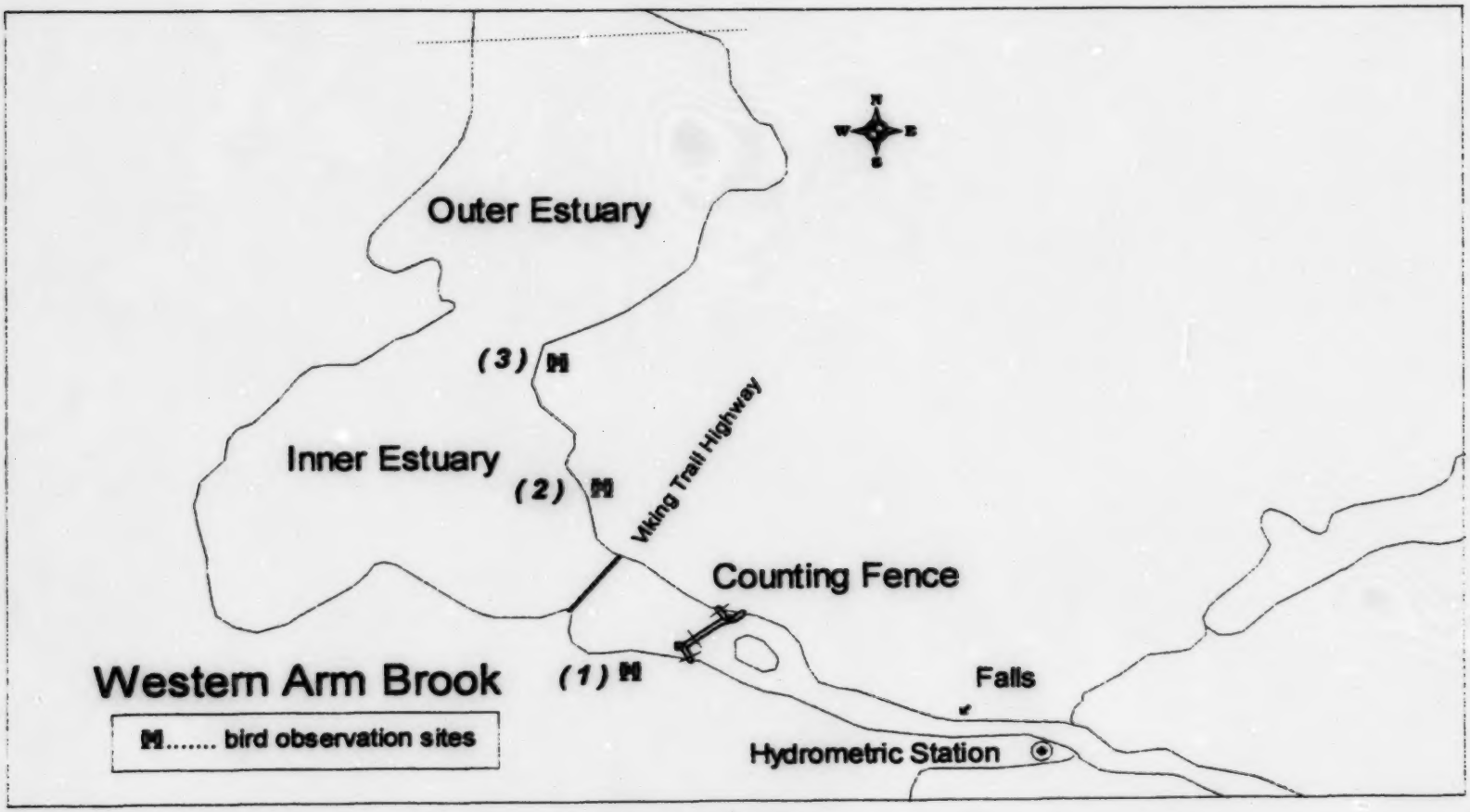


Figure 2. Location of bird observation sites at Western Arm Brook.

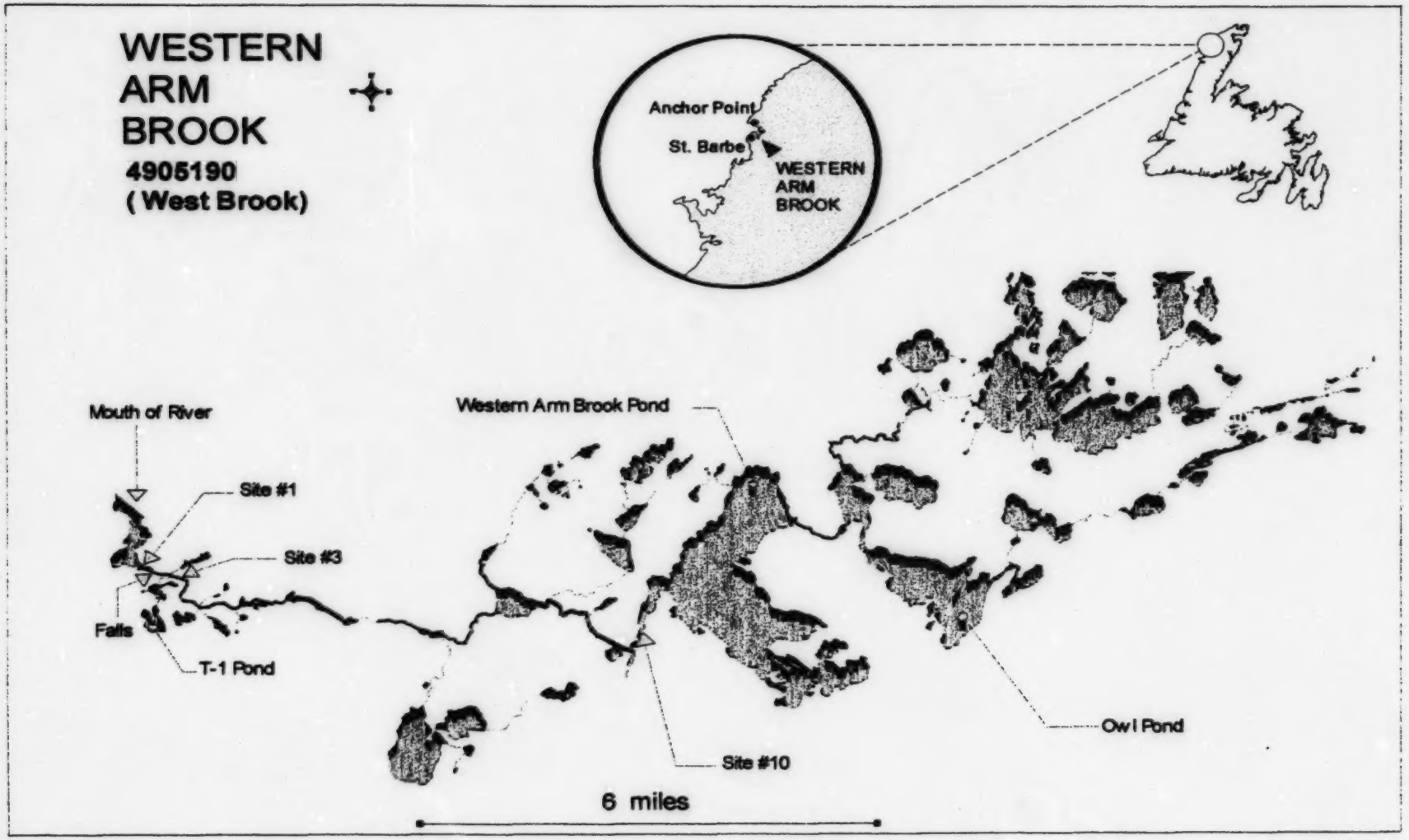


Figure 3. Location of electrofishing sites at Western Arm Brook.

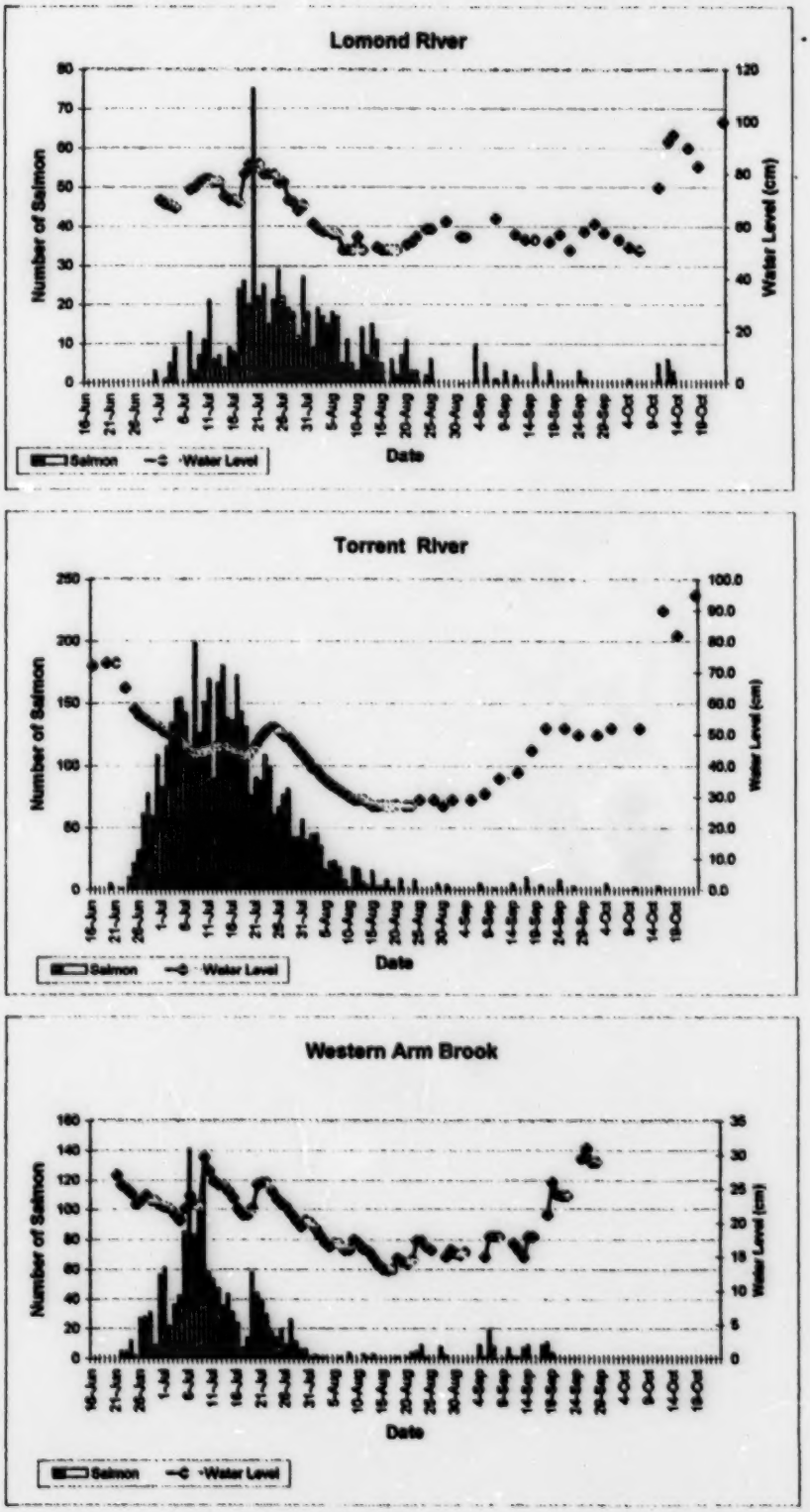
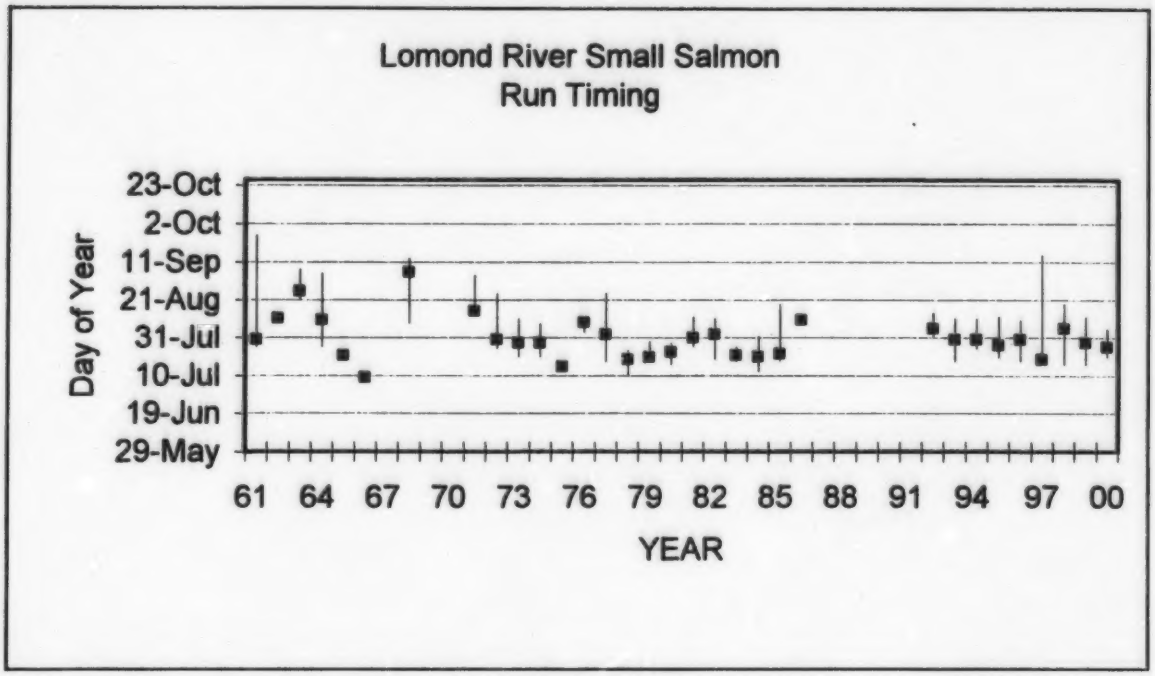


Figure 4. Daily counts of small and large Atlantic salmon and mean daily water level at counting facilities on Lomond River, Torrent River, and Western Arm Brook, 2000.



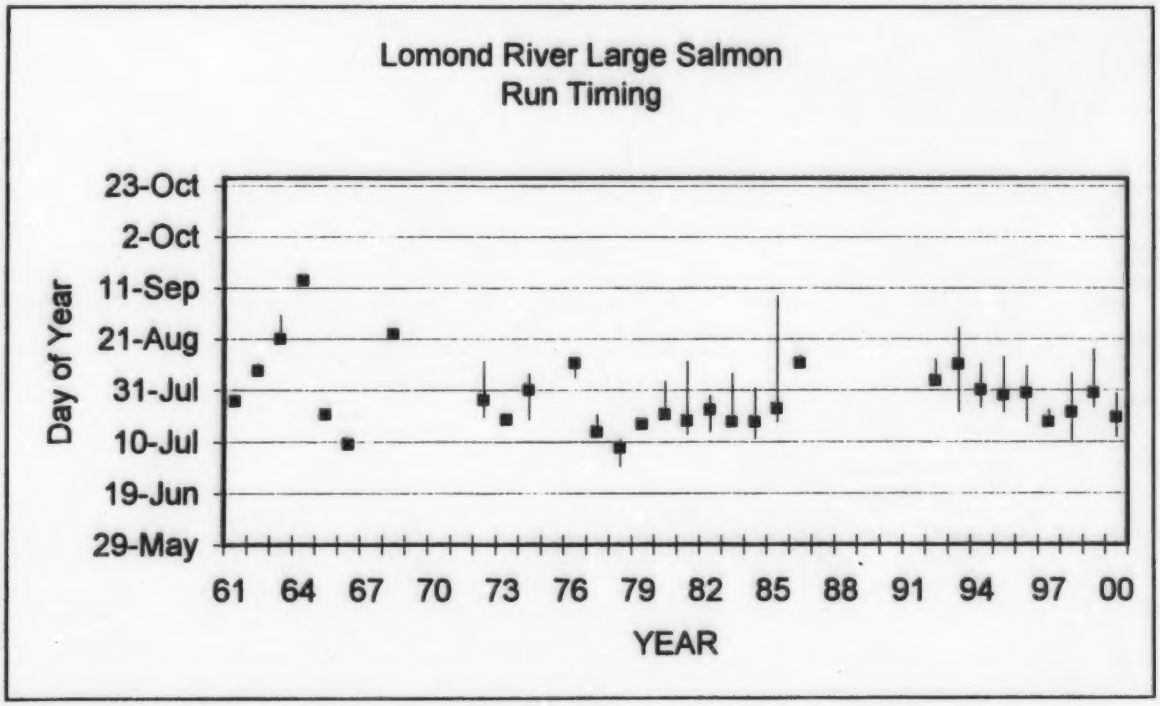
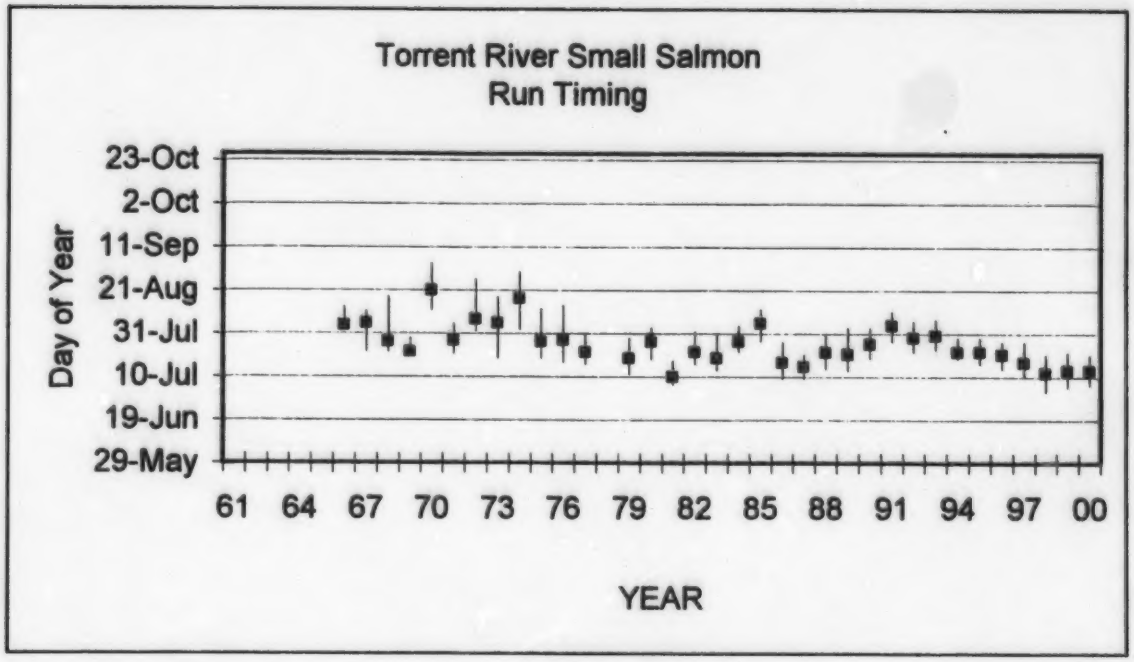


Figure 5. Run timing of small and large Atlantic salmon at Lomond River, 1961-2000. Vertical lines represent 25% to 75% of the run and squares represent 50% of the run.



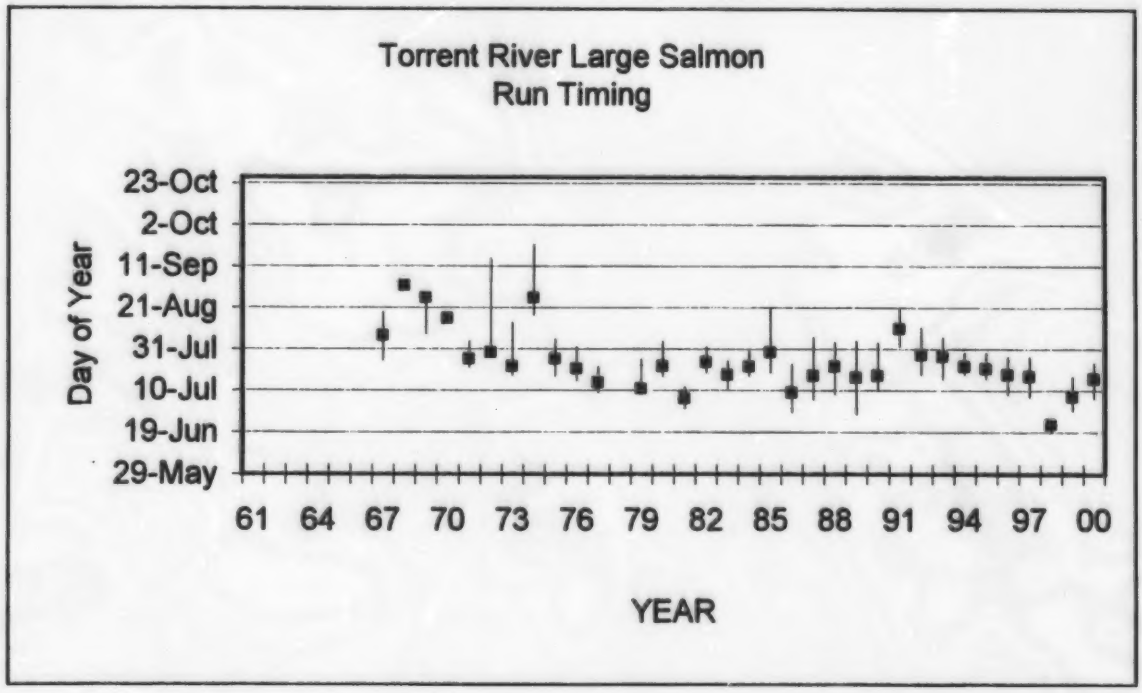
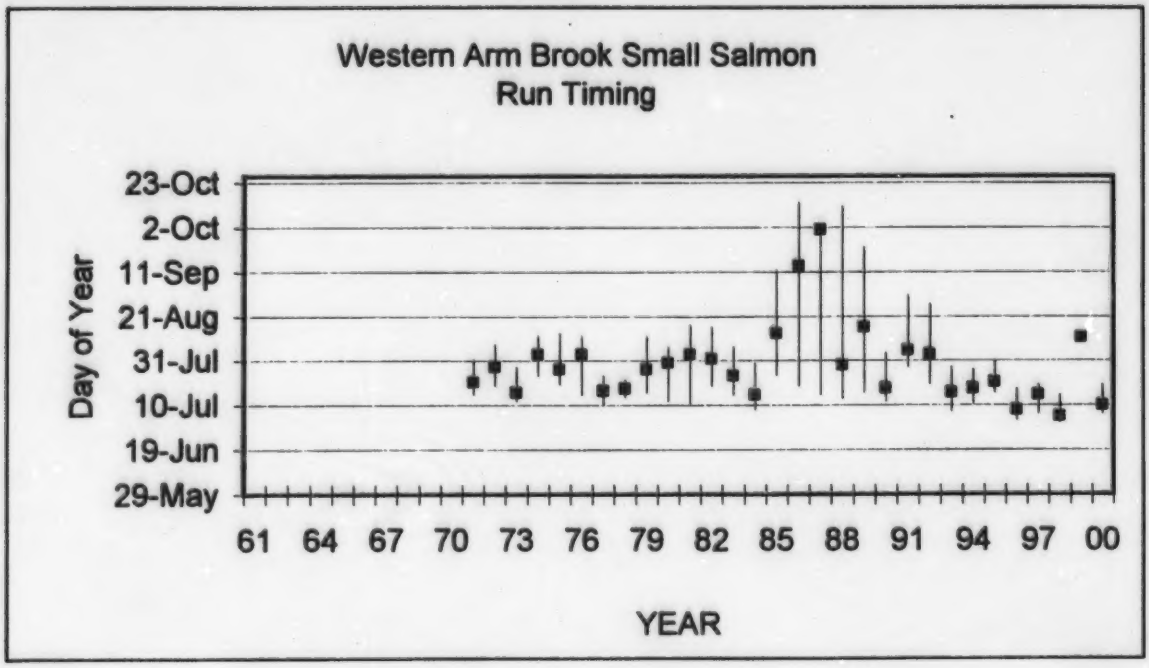


Figure 6. Run timing of small and large Atlantic salmon at Torrent River, 1961-2000. Vertical lines represent 25% to 75% of the run and squares represent 50% of the run.



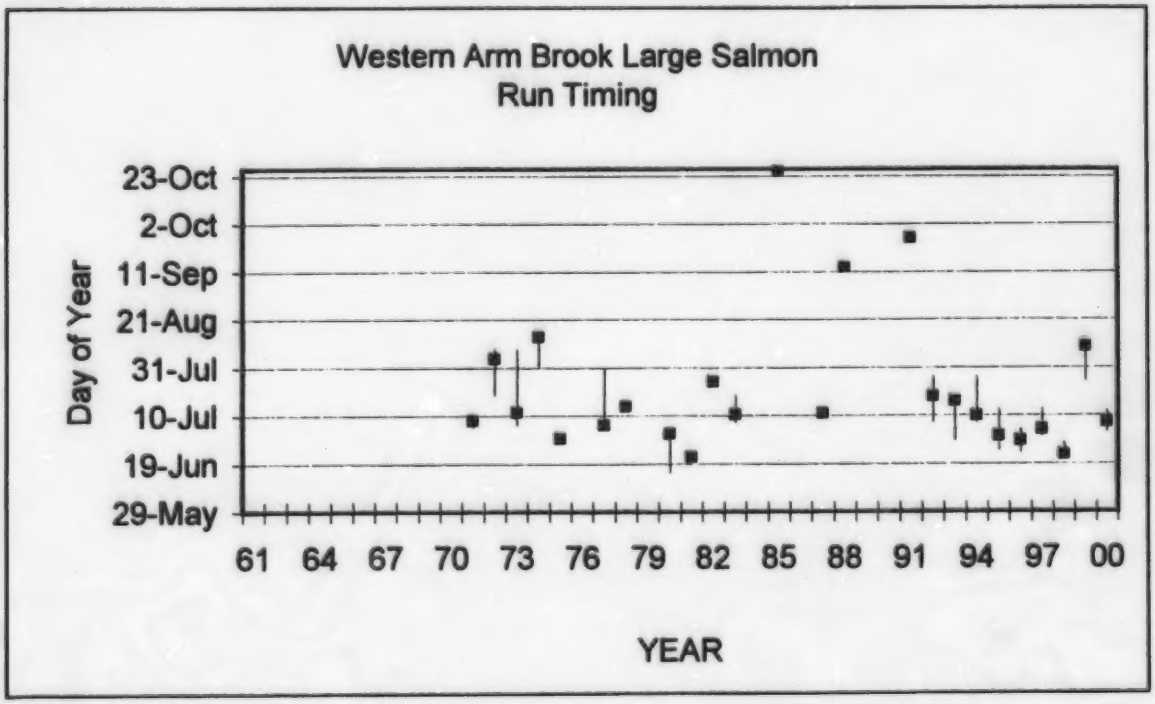


Figure 7. Run timing of small and large Atlantic salmon at Western Arm Brook, 1961-2000. Vertical lines represent 25% to 75% of the run and squares represent 50% of the run.

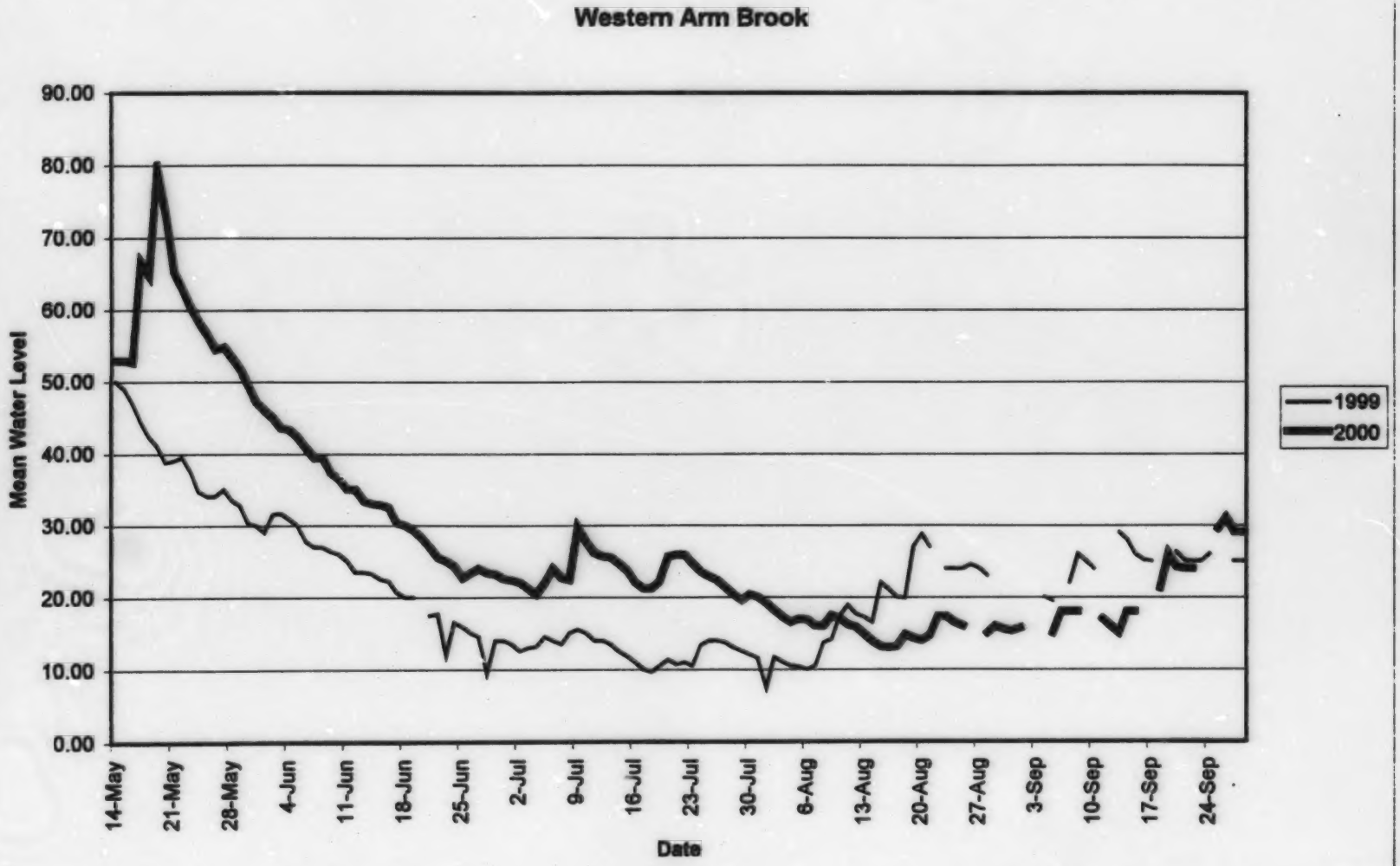


Figure 8. Mean daily water level recorded at the counting fence on Western Arm Brook, 1999 and 2000.

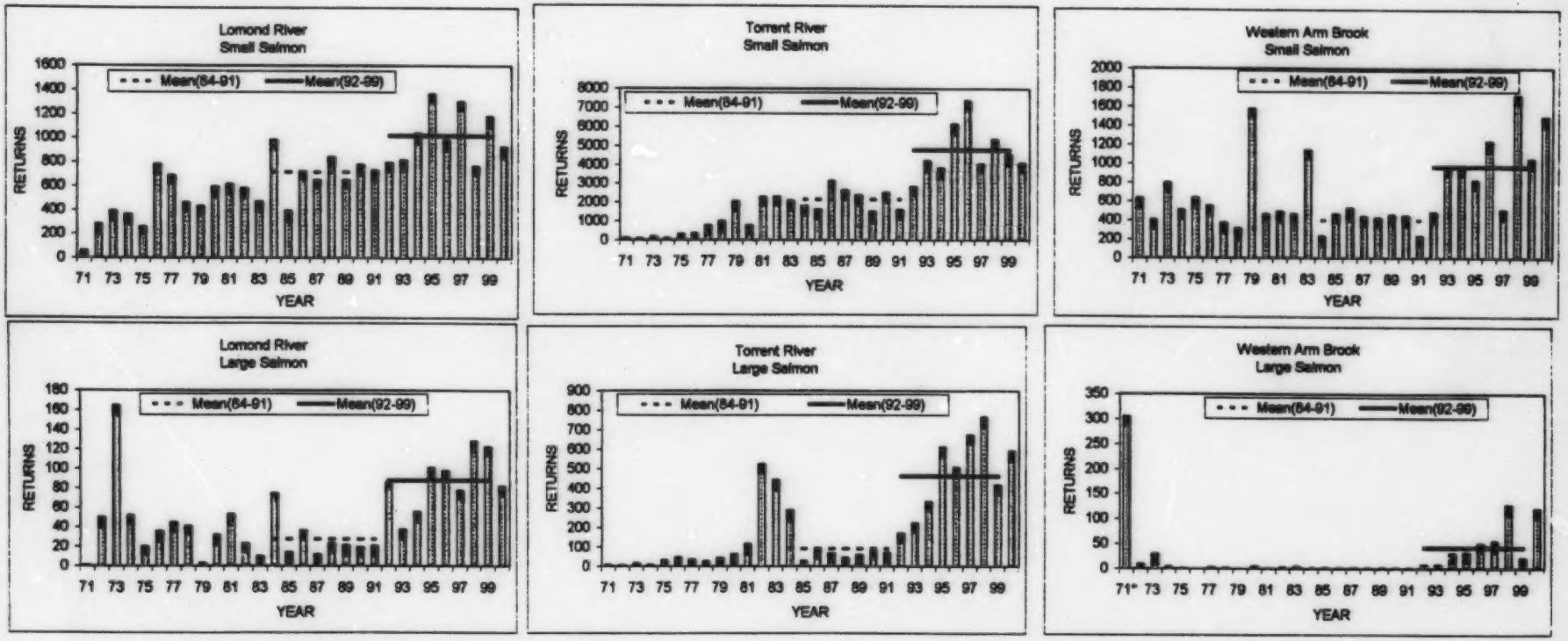


Figure 9. Returns of small and large Atlantic salmon to Lomond River, Torrent River and Western Arm Brook, 1971-2000. Dashed horizontal line represents the 1984-1991 mean and the solid horizontal line represents the 1992-1999 mean. * Incorrect sizing suspected (Moores and Ash, 1984).

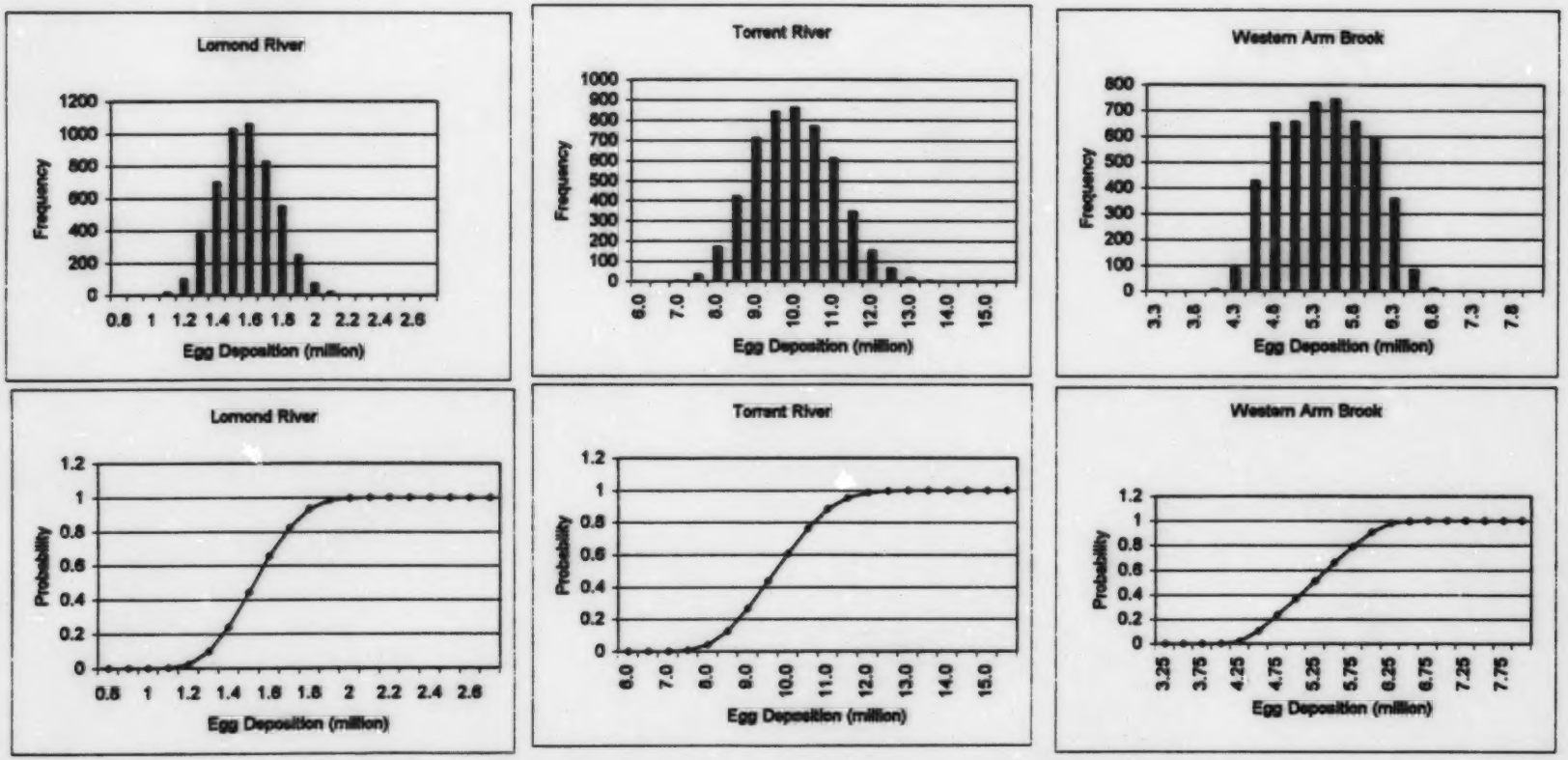


Figure 10. Frequency distribution and cumulative probability distribution of potential egg depositions calculated for Lomond River, Torrent River and Western Arm Brook, 2000. Parameter values for percentage female of small and large salmon was varied within a uniform distribution and fecundity varied by a 20% coefficient of variation.

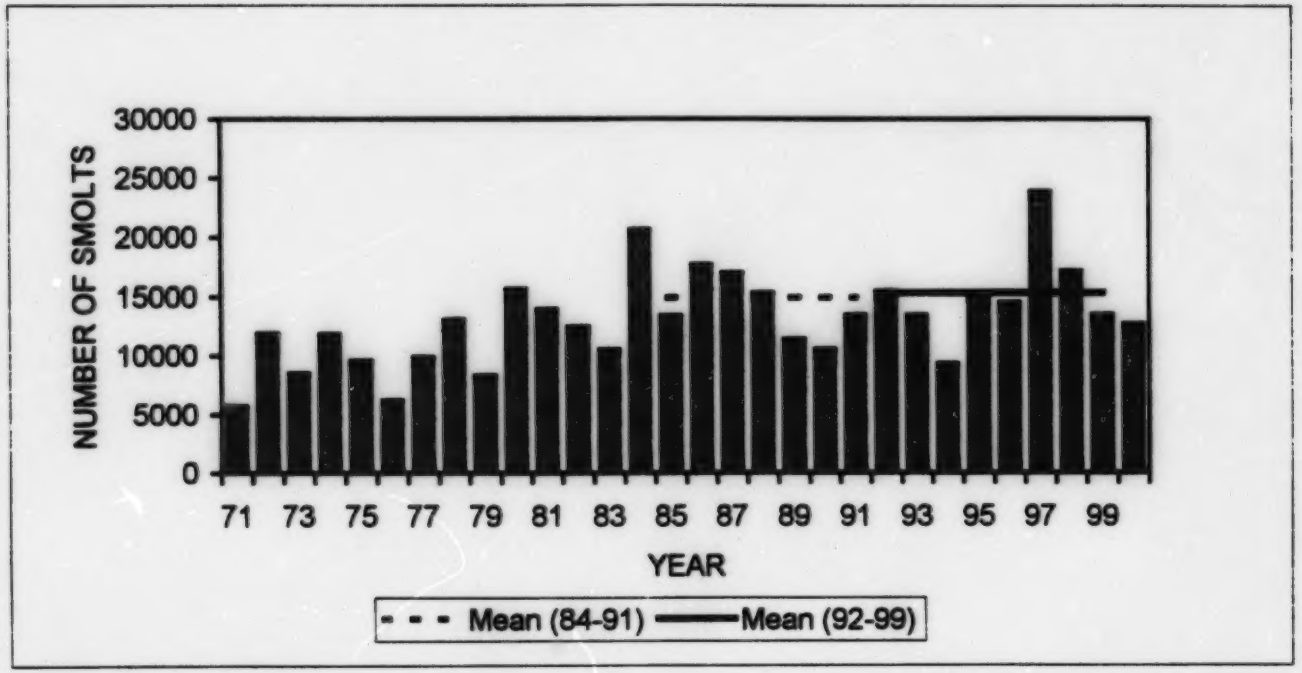


Figure 11. Counts of Atalntic salmon smolts at the counting fence on Western Arm Brook, 1971-2000. Dashed horizontal line represents the 1984-1991 mean and the solid horizintal line represents the 1992-1999 mean.

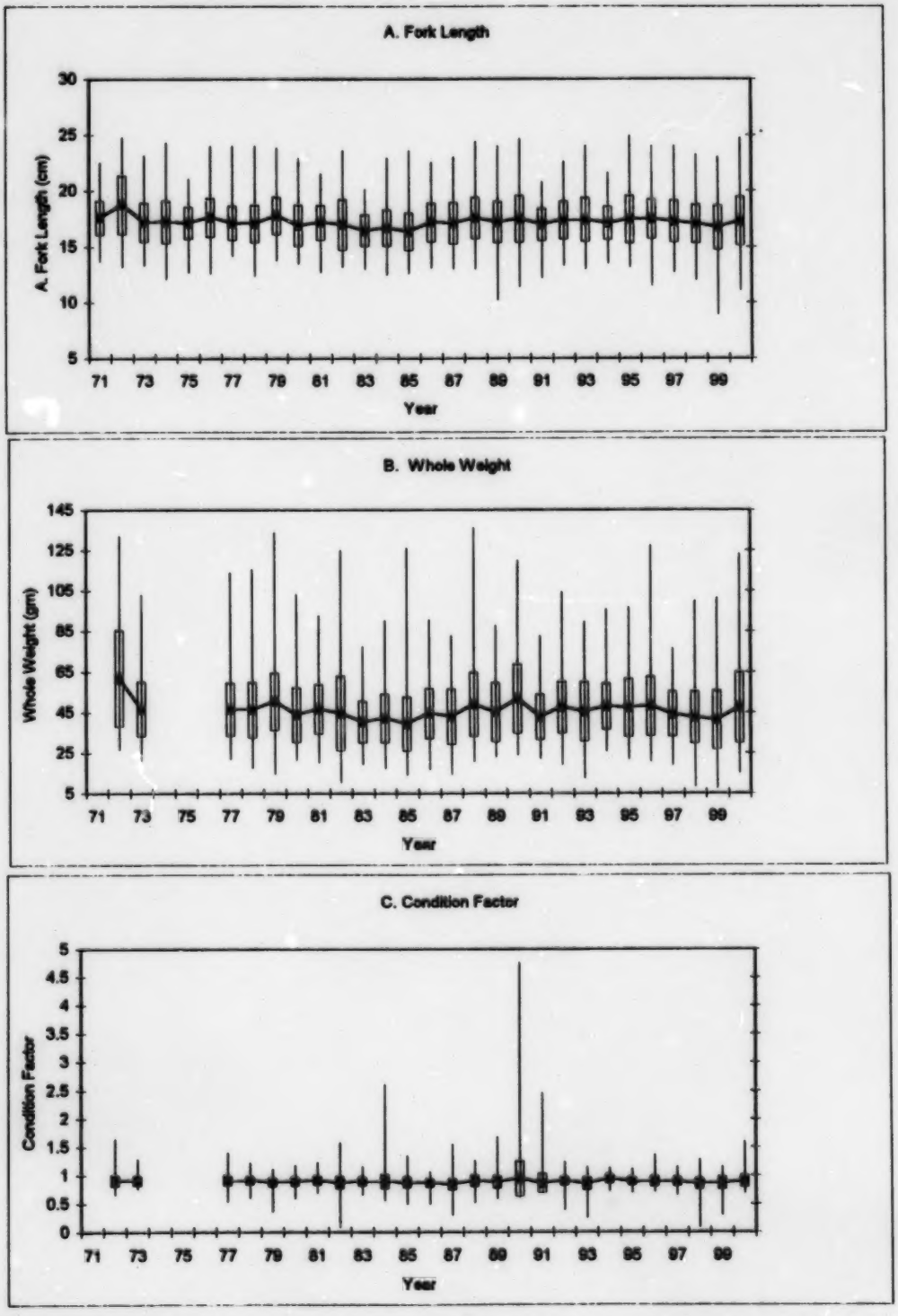


Figure 12. Mean fork length, whole weight and condition factor of salmon smolts at Western Arm Brook, 1971-2000. Symbols represent: the mean, minimum, maximum and standard deviation.

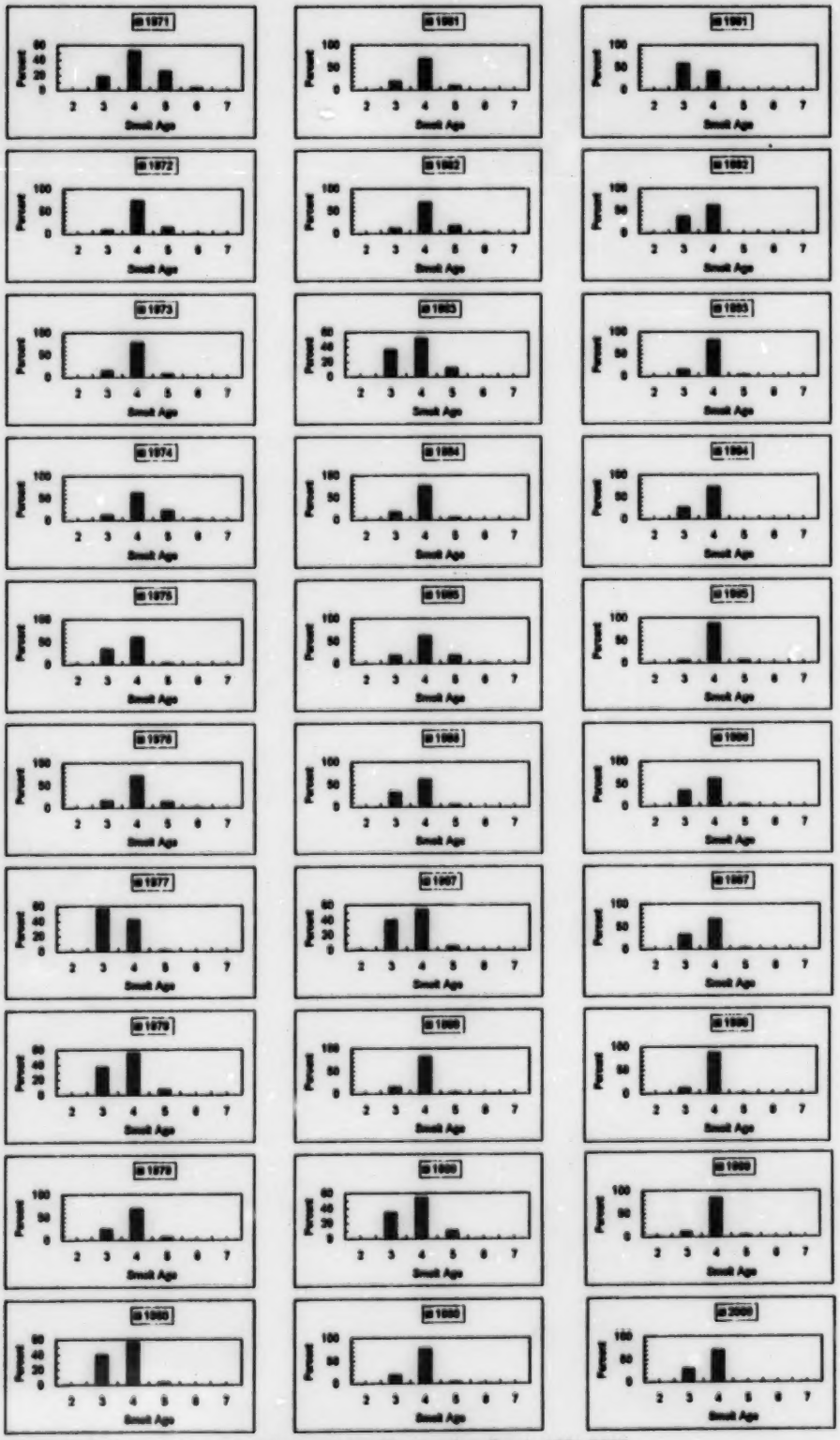


Figure 13. Age distribution of smolts sampled at Western Arm Brook, 1971-2000.

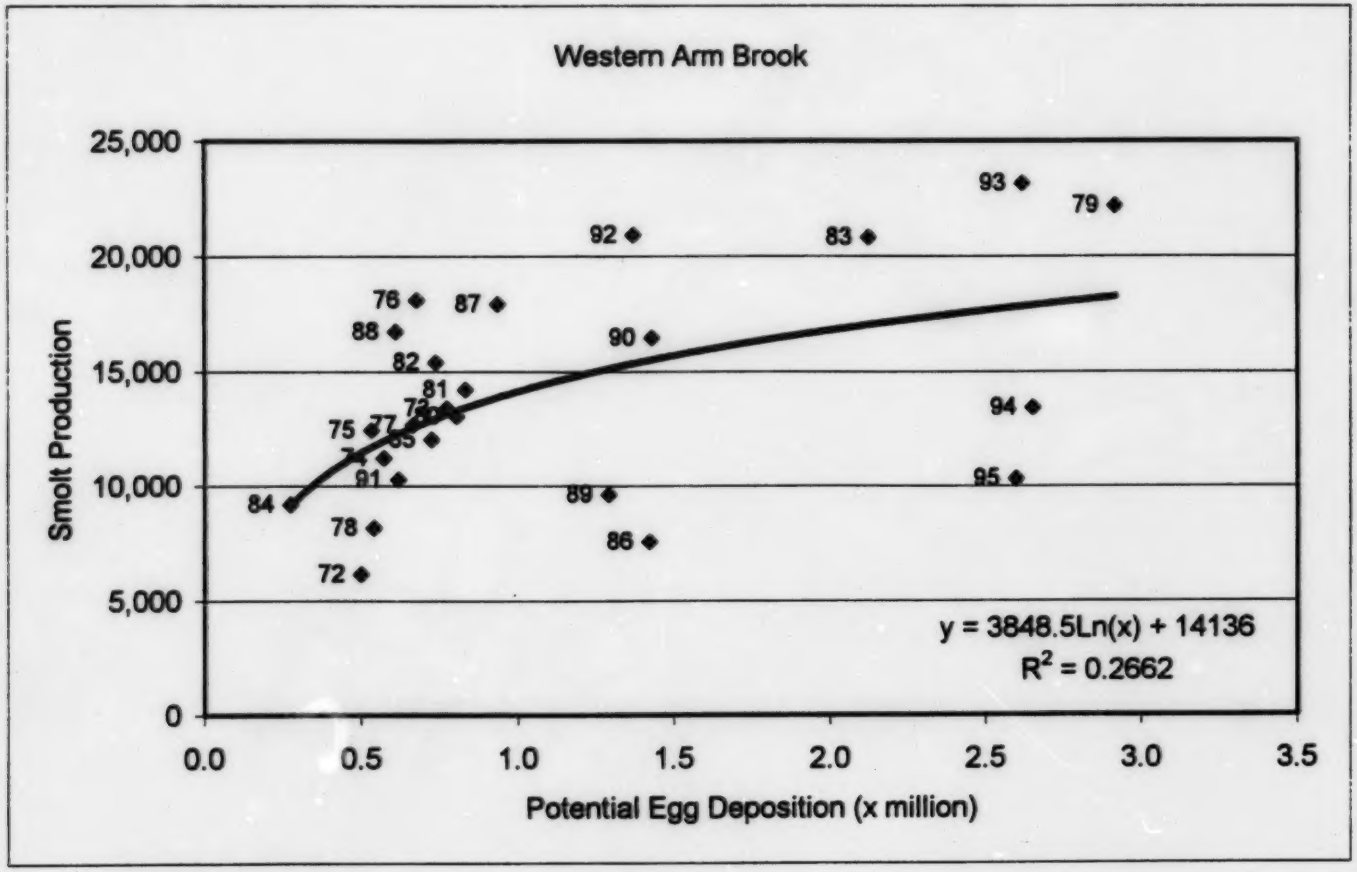


Figure 14. Variation in smolt production with changing egg deposition at Western Arm Brook. The 1995 year-class was complete to age-4 smolts in 2000. The 1996 year-class will contribute age-4 smolts to the smolt production in 2001.

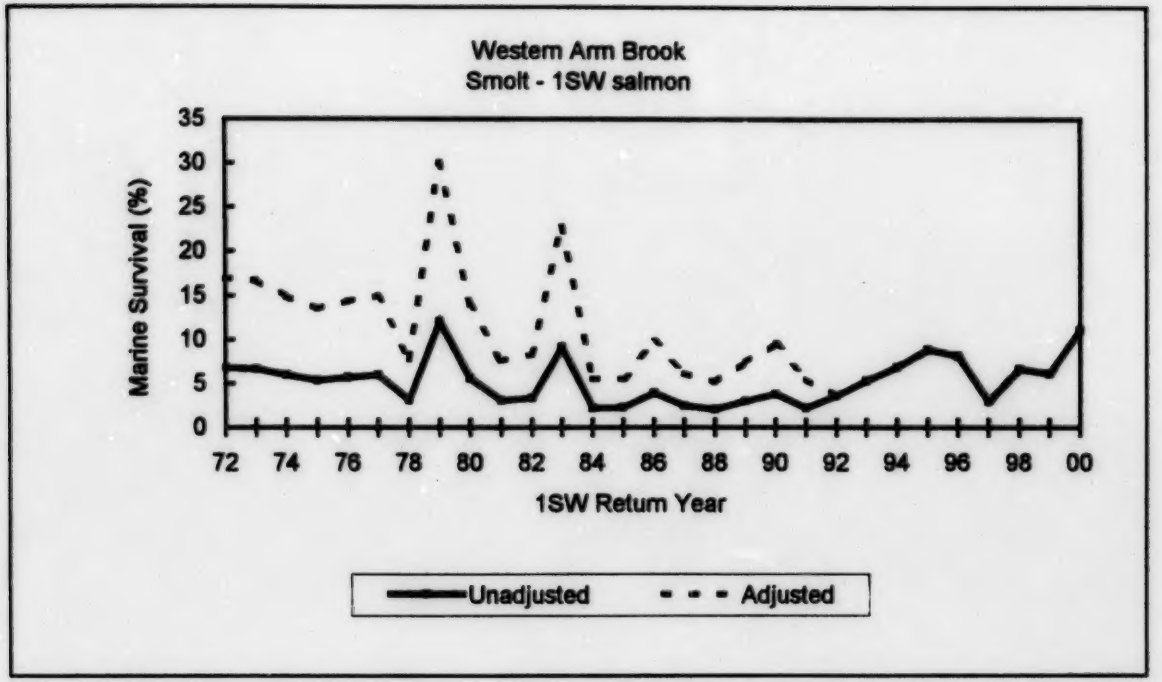


Figure 15. Annual variation in marine survival of Atlantic salmon smolts to one sea winter adults on Western Arm Brook, 1972-2000. Dashed line represents adjustment for commercial fishery removals.

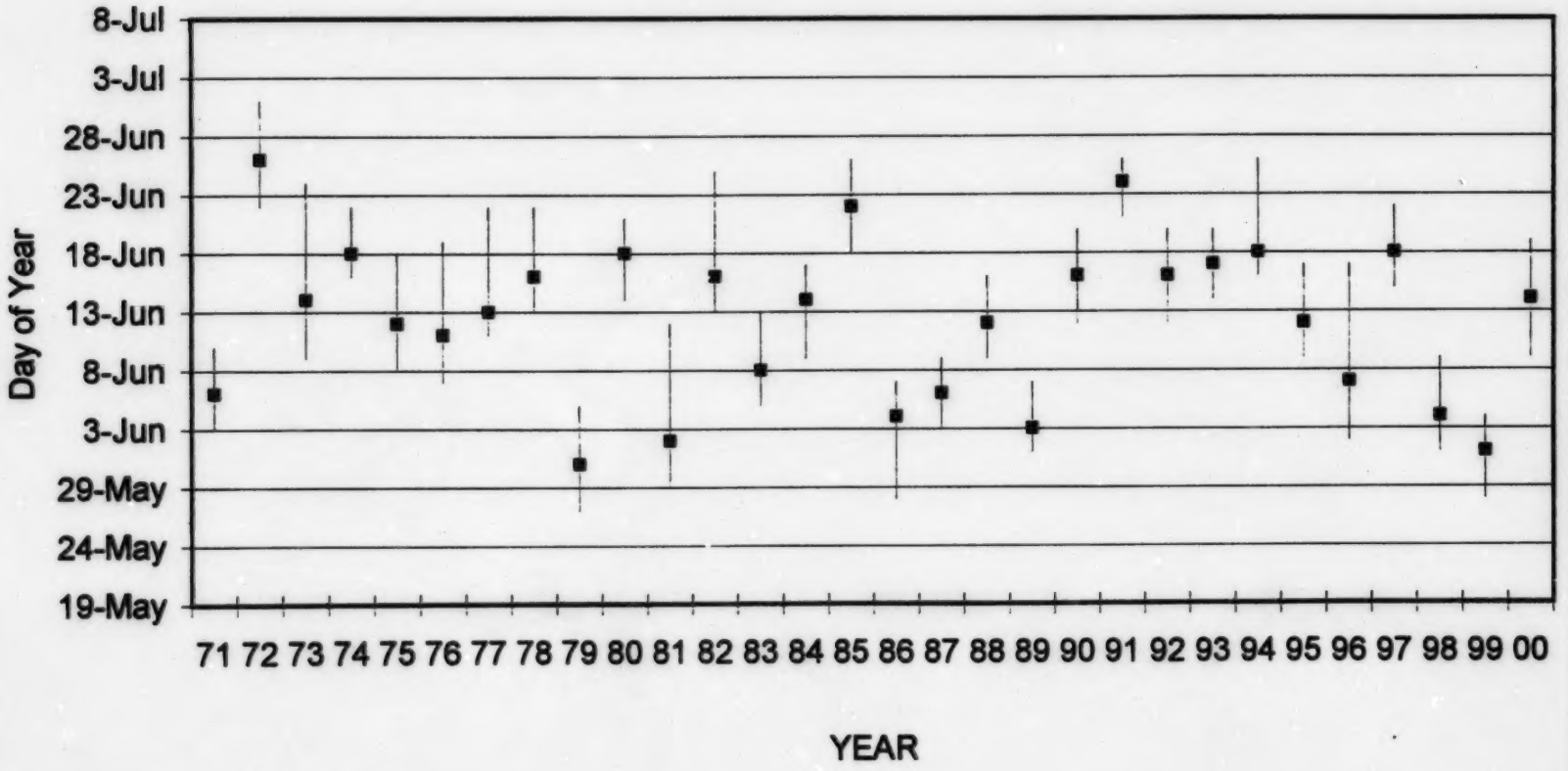


Figure 16. Run timing of Atlantic salmon smolts at Western Arm Brook, 1971-2000. Vertical lines represent 25% to 75% of the run and squares represent 50% of the run.

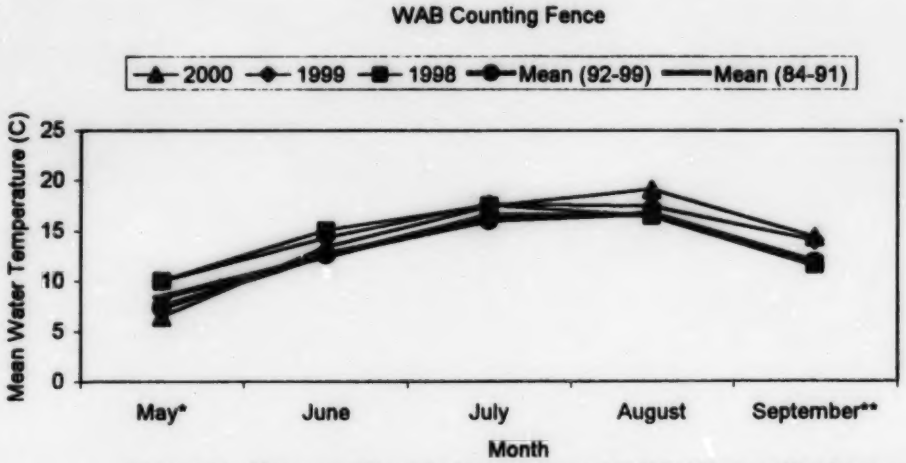


Figure 17a. Mean monthly water temperature recorded at the counting fence on Western Arm Brook, 1984-2000. * Mean for May is May 20-31 except for 1995 from May 26-31 and for 2000 the mean for September is from 1-5.

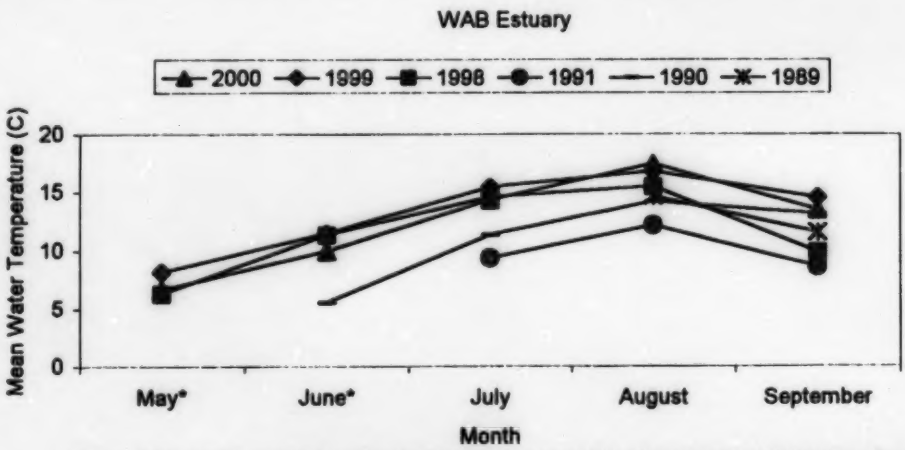


Figure 17b. Mean monthly water temperature recorded in the estuary of Western Arm Brook, 1989-2000. Thermometer is located 2m off the bottom. * May temperatures were from May 20-31 and the June 1990 mean is from June 13-30.

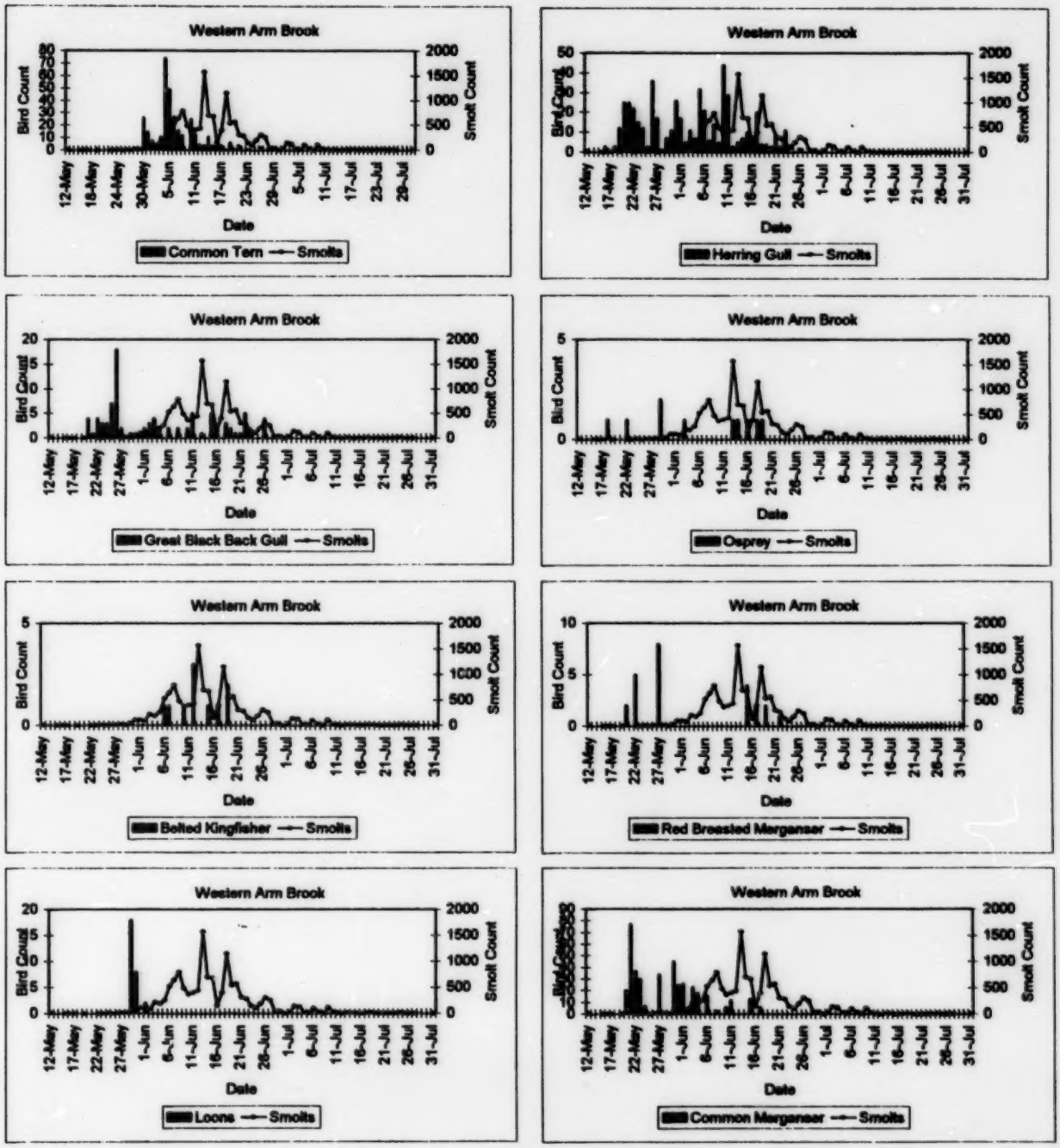
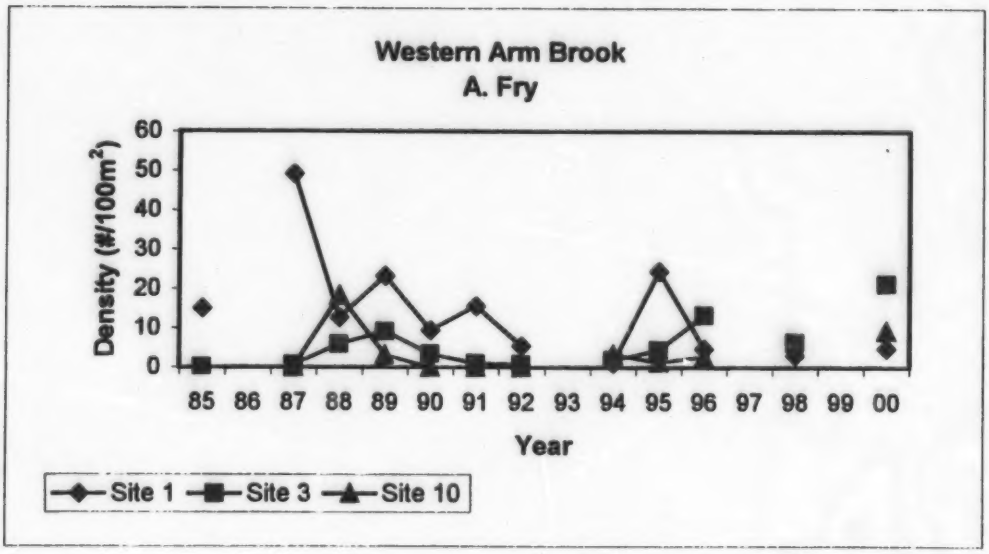


Figure 18. Daily bird counts at Western Arm Brook and smolt counts in 2000.



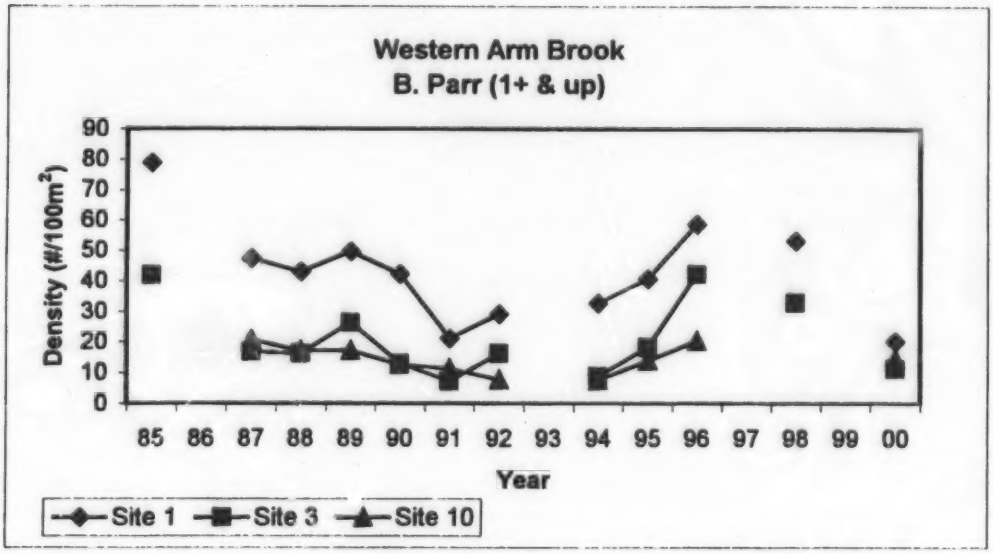


Figure 19. Densities of fry (age 0+) and parr (1+&up, 1+, and 2+) at sites 1, 3, 10 on Western Arm Brook, 1985-96, 1998 and 2000. Data collected in 1993 was incomplete and eliminated from the calculations. In 1998, data from site 10 was incomplete due to malfunction of equipment. Elecrtrofishing was not conducted on the sites in 1997 and 1999.

Appendix 1. Recreational salmon fishery catch and effort data, 1974-2000.
River: Lomond River

Code: 4503920

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	1331	324	.	324	19	.	19	343	.	343	0.26
1975	773	258	.	258	20	.	20	278	.	278	0.36
1976	2045	650	.	650	25	.	25	675	.	675	0.33
1977	1461	495	.	495	34	.	34	529	.	529	0.36
1978	1267	345	.	345	29	.	29	374	.	374	0.30
1979	900	235	.	235	2	.	2	237	.	237	0.26
1980	1218	293	.	293	13	.	13	306	.	306	0.25
1981	1446	507	.	507	3	.	3	510	.	510	0.35
1982	1435	308	.	308	7	.	7	315	.	315	0.22
1983	1112	251	.	251	3	.	3	254	.	254	0.23
1984	1505	546	.	546	28	.	28	574	.	574	0.38
1985	1075	203	.	203	*	2	2	203	2	205	0.19
1986	1164	371	.	371	*	46	46	371	46	417	0.36
1987	1186	297	.	297	*	12	12	297	12	309	0.26
1988	1545	404	.	404	*	25	25	404	25	429	0.28
1989	1714	270	.	270	*	5	5	270	5	275	0.16
1990	1938	386	.	386	*	17	17	386	17	403	0.21
1991	1591	328	.	328	*	10	10	328	10	338	0.21
1992	1612	357	24	381	*	56	56	357	80	437	0.27
1993	2190	281	85	366	*	40	40	281	125	406	0.19
1994	2017	325	116	441	*	58	58	325	174	499	0.25
1995	2043	343	190	533	*	62	62	343	252	595	0.29
1996	2702	371	99	470	*	49	49	371	148	519	0.19
1997**		490	273	763	*	52	52	490	325	815	
1998**		201	226	427	*	23	23	201	249	450	
1999**		335	148	483	*	97	97	335	245	580	
2000**		263	64	327	*	11	11	263	75	338	
84-89 $\bar{X}$	1384.8	348.5	.	348.5	.	18.0	19.7	353.2	18.0	368.2	0.27
95% CL	269.8	126.5	.	126.5	.	22.3	17.4	136.3	22.3	138.7	0.10
N	6	6	0	6	0	5	6	6	5	6	6
86-91 $\bar{X}$	1523.0	342.7	.	342.7	.	19.2	19.2	342.7	19.2	361.8	0.24
95% CL	317.1	55.6	.	55.6	.	15.5	15.5	55.6	15.5	66.6	0.07
N	6	6	0	6	0	6	6	6	6	6	6
92-96 $\bar{X}$	2112.8	335.4	102.8	438.2	.	53.0	53.0	335.4	155.8	491.2	0.23
95% CL	488.0	43.3	74.3	84.4	.	10.8	10.8	43.3	79.3	91.7	0.06
N	5	5	5	5	0	5	5	5	5	5	5

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985 - 1996 AND ON RETAINED FISH ONLY PRIOR TO 1985.
* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.
**DATA OBTAINED FROM THE LICENSE STUB RETURN; 2000 DATA ARE PRELIMINARY

Appendix 2. Recreational salmon fishery catch and effort data, 1974-2000.
River: Torrent River

Code: 4704800

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	400	58	.	58	4	.	4	62	.	62	0.16
1975	364	123	.	123	6	.	6	129	.	129	0.35
1976	.	.	.	.	.	.	.	.	.	.	.
1977	.	.	.	.	.	.	.	.	.	.	.
1978	183	31	.	31	4	.	4	35	.	35	0.19
1979	238	65	.	65	3	.	3	68	.	68	0.29
1980	.	.	.	.	.	.	.	.	.	.	.
1981	656	167	.	167	18	.	18	185	.	185	0.28
1982	535	187	.	187	2	.	2	189	.	189	0.35
1983	354	82	.	82	1	.	1	83	.	83	0.23
1984	.	.	.	.	.	.	.	.	.	.	.
1985	251	70	.	70	*	0	0	70	0	70	0.28
1986	767	340	.	340	*	5	5	340	5	345	0.45
1987	576	165	.	165	*	1	1	165	1	166	0.29
1988	803	313	.	313	*	0	0	313	0	313	0.39
1989	559	143	.	143	*	0	0	143	0	143	0.26
1990	629	222	.	222	*	4	4	222	4	226	0.36
1991	438	150	.	150	*	1	1	150	1	151	0.34
1992	833	477	75	552	*	6	6	477	81	558	0.67
1993	619	179	266	445	*	15	15	179	281	460	0.74
1994	992	227	82	309	*	9	9	227	91	318	0.32
1995	1816	331	369	700	*	36	36	331	405	736	0.41
1996	2027	421	270	691	*	20	20	421	290	711	0.35
1997**		327	469	796	*	79	79	327	548	875	
1998**		275	552	827	*	89	89	275	641	916	
1999**		477	603	1080	*	174	174	477	777	1254	
2000**		309	332	641	*	55	55	309	387	696	
84-89 $\bar{X}$	591.2	206.2	.	206.2	.	1.2	1.2	206.2	1.2	207.4	0.35
95% CL	272.5	143.6	.	143.6	.	2.7	2.7	143.6	2.7	145.3	0.11
N	5	5	0	5	0	5	5	5	5	5	5
86-91 $\bar{X}$	628.7	222.2	.	222.2	.	1.8	1.8	222.2	1.8	224.0	0.36
95% CL	143.5	90.1	.	90.1	.	2.2	2.2	90.1	2.2	91.3	0.08
N	6	6	0	6	0	6	6	6	6	6	6
92-96 $\bar{X}$	1257.4	327.0	212.4	539.4	.	17.2	17.2	327.0	229.6	556.6	0.44
95% CL	775.9	156.1	160.2	206.7	.	14.7	14.7	156.1	173.7	217.1	0.17
N	5	5	5	5	0	5	5	5	5	5	5

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985 - 1996 AND ON RETAINED FISH ONLY PRIOR TO 1985.
* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.
**DATA OBTAINED FROM THE LICENSE STUB RETURN; 2000 DATA ARE PRELIMINARY

Appendix 3. Recreational salmon fishery catch and effort data, 1974-2000.
River: West River (Western Arm Brook) Code: 4905190

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	361	124	.	124	0	.	0	124	.	124	0.34
1975	155	8	.	8	0	.	0	8	.	8	0.05
1976	115	32	.	32	0	.	0	32	.	32	0.28
1977	107	11	.	11	0	.	0	11	.	11	0.10
1978	168	22	.	22	1	.	1	23	.	23	0.14
1979	5	0	.	0	0	.	0	0	.	0	0.00
1980	175	30	.	30	2	.	2	32	.	32	0.18
1981	209	41	.	41	0	.	0	41	.	41	0.20
1982	379	73	.	73	0	.	0	73	.	73	0.19
1983	15	0	.	0	0	.	0	0	.	0	0.00
1984	432	115	.	115	0	.	0	115	.	115	0.27
1985	204	46	.	46	*	0	0	46	0	46	0.23
1986	.	.	.	.	*	.	.	.	.	.	.
1987	269	59	.	59	*	2	2	59	2	61	0.23
1988	701	171	.	171	*	0	0	171	0	171	0.24
1989	.	.	.	.	*	.	.	.	.	.	.
1990	.	.	.	.	*	.	.	.	.	.	.
1991	.	.	.	.	*	.	.	.	.	.	.
1992	.	.	.	.	*	.	.	.	.	.	.
1993	.	.	.	.	*	.	.	.	.	.	.
1994	.	.	.	.	*	.	.	.	.	.	.
1995	.	.	.	.	*	.	.	.	.	.	.
1996	.	.	.	.	*	.	.	.	.	.	.
1997**	.	.	.	.	*	.	.	.	.	.	.
1998**	.	.	.	.	*	.	.	.	.	.	.
1999**	.	.	.	.	*	.	.	.	.	.	.
2000***	384	21	.	.	*	.	.	21	.	21	0.055
84-89 $\bar{X}$	401.5	97.8	.	97.8	.	0.7	0.5	97.8	0.7	98.3	0.24
95% CL	406.9	105.2	.	105.2	.	3.5	1.8	105.2	3.5	104.4	0.03
N	4	4	0	4	0	3	4	4	3	4	4
86-91 $\bar{X}$	485.0	115.0	.	115.0	.	1.0	1.0	115.0	1.0	116.0	0.24
95% CL	3881.3	1006.3	.	1006.3	.	18.0	18.0	1006.3	18.0	988.3	0.09
N	2	2	0	2	0	2	2	2	2	2	2
92-96 $\bar{X}$	0.0	0.0	0.0	0.0	.	0.0	0.0	0.0	0.0	0.0	0.00
95% CL	0.0	0.0	0.0	0.0	.	0.0	0.0	0.0	0.0	0.0	0.00
N	5	5	5	5	0	5	5	5	5	5	5

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985 - 1996 AND ON RETAINED FISH ONLY PRIOR TO 1985.
* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.
**DATA OBTAINED FROM THE LICENSE STUB RETURN
***DATA OBTAINED FROM BIOLOGICAL SAMPLING BY ANGLING